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NATIONAL DAM INSPECTION PROGRAM. HUTCHINSON RESERVOIR DAM NUMBE--ETC(U)

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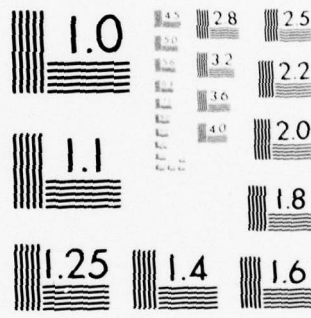
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National Dam Inspection Program.
Hutchinson Reservoir Dam Number 1
(NDI-PA-214), Ohio River Basin, Redstone
Creek, Fayette County, Pennsylvania.
Phase I Inspection Report.

AD A068693

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D. C. 20314.

The purpose of a Phase I investigation is to expeditiously identify those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases such as the one encountered at Hutchinson Reservoir Dam No. 1 where the reservoir was lower than the spillway crest (normal pool) at the time of inspection, certain conditions may be obscured which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspection can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

PHASE I REPORT
National Dam Inspection Program

ABSTRACT

Hutchinson Reservoir Dam No. 1: NDS I.D. No. PA-00214

Owner: Western Pennsylvania Water Company
State Located: Pennsylvania (PennDER I.D. No. 26-13)
County Located: Fayette County
Stream: Redstone Creek
Inspection Date(s): 6 October 1978
Inspection Team: GAI Consultants, Inc.
570 Beatty Road
Monroeville, Pennsylvania 15146

The visual inspection, operational history and hydrologic/hydraulic analysis indicate the facility is in poor condition. Apparent rotation of the outlet riser structure, unevenness of the upstream face and a sinkhole in the crest suggest possible internal piping problems which are possibly active under normal or high pool conditions. Records of past performance show numerous problems related to seepage both under and through the embankment during its 91 year life span.

Based on recommended guidelines, it has been determined that the Spillway Design Flood (SDF) for this facility is the Probable Maximum Flood (PMF). Hydrologic and hydraulic calculations indicate that the reservoir and existing spillway system will pass only 33 percent of the (PMF) before overtopping occurs. Under 1/2 PMF conditions, it has also been determined that the embankment will be overtopped leading to failure and a significant increase in the hazard to loss of life downstream. As the hazard rating is "high" the present spillway condition is assessed as being "seriously inadequate."

The inadequacies of the spillway and evidence of possible internal piping are deficiencies of such a nature that if left uncorrected could result in the failure of the dam with subsequent increase in the potential for loss of life and/or substantial property damage. Thus, the facility is considered unsafe. Failure does not appear imminent, under the

conditions which existed at the time of inspection; however, a detailed emergency operation plan and warning system should be immediately activated which includes around-the-clock surveillance during periods of unusually heavy precipitation by a registered professional engineer experienced in the design and performance evaluation of earth structures.

It is recommended that the owner:

1. Perform a detailed hydrologic and hydraulic evaluation of the facility including an assessment of downstream effects if the facility is breached or removed from the system that includes Hutchinson Reservoir Dams Nos. 1, 2 and 3.
2. Perform a detailed subsurface evaluation to determine the cause of sinkhole development in the crest and the in-situ properties of the embankment materials.
3. Perform a stability and seepage evaluation of the embankment under all possible operating conditions utilizing the results of Item 2 above.
4. Determine the extent of apparent structural distress in the outlet structure.
5. Take appropriate remedial actions based on results of the above analyses.
6. Immediately activate a plan for emergency operation and a warning system for downstream residents. Included in the plan should be provisions for around-the-clock surveillance of the facility by a professional engineer experienced in the design and performance evaluation of earth structures during periods of unusually heavy precipitation.
7. Inspect the facility on a daily basis to determine if the sinkhole development in the crest is an active process requiring immediate remedial action. Particular attention should be given to the seepage at the outlet conduit and the apparent seepage near the toe of the left abutment. This area should also be cleared of all brush and debris to facilitate inspection.
8. Monitor apparent movements of the outlet structure.

BMM/jh

GAI Consultants, Inc.

Approved by:

Bernard M. Mihalcin
Bernard M. Mihalcin, P.E.

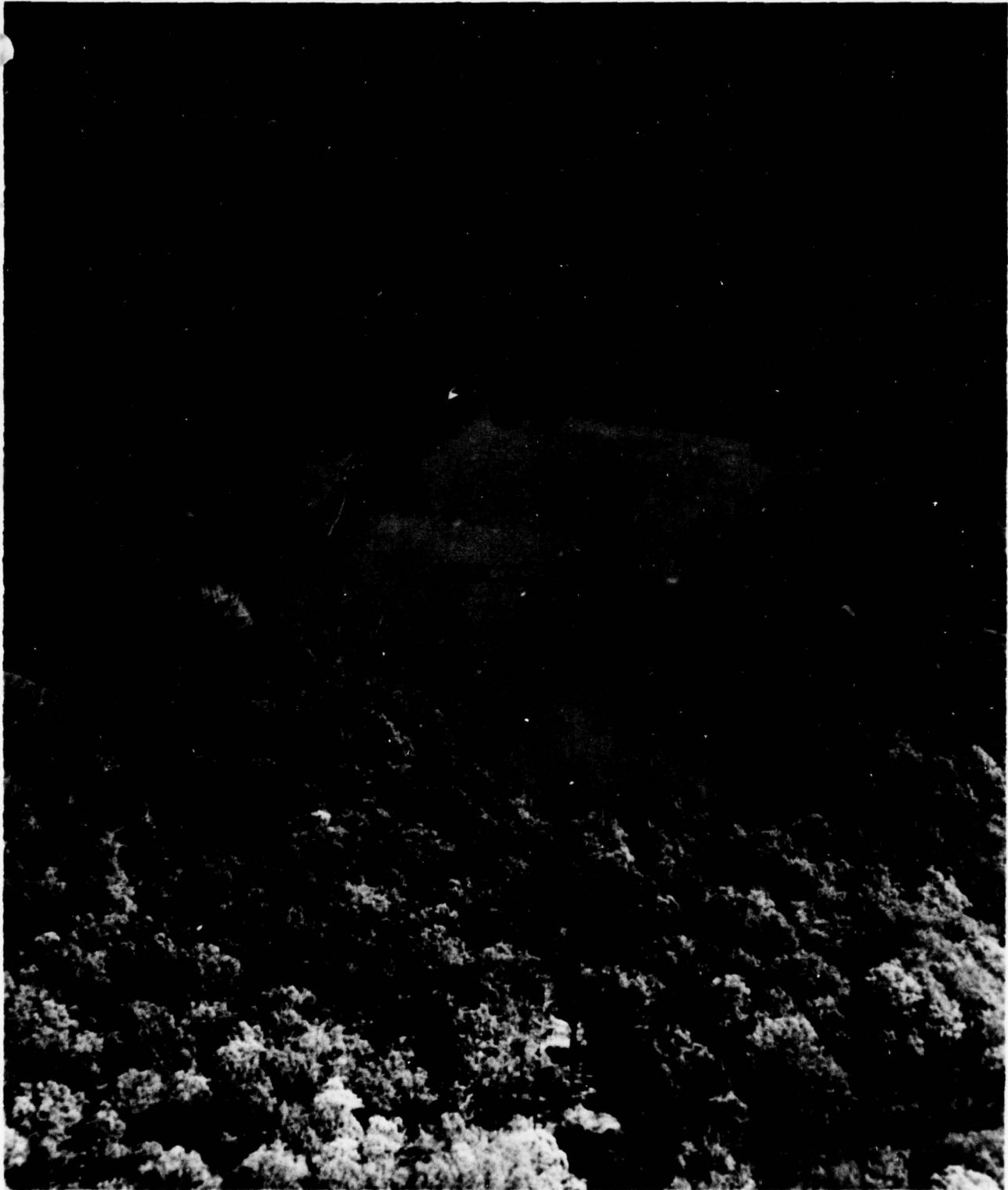
G. K. Withers
G. K. WITHERS
Colonel, Corps of Engineers
District Engineer



Date 9 Feb 1979

Date 3 Mar 79

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Overview Photograph of Hutchinson Reservoirs Nos. 1, 2, and 3

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
HUTCHINSON RESERVOIR DAM NO. 1
NDI# PA-214, PENNDER# 26-13

SECTION 1
GENERAL INFORMATION

1.0 Authority.

The Dam Inspection Act. Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

1.1 Purpose.

The purpose is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Hutchinson Reservoir Dam No. 1 is an earth embankment (with an upstream concrete face) approximately 308 feet in length and with a maximum height of 33 feet. The embankment reportedly is provided with a 2-foot thick clay puddle core wall extending 14 feet below the original ground surface.

The facility is served by a rectangular concrete overflow spillway with a multiple vertical drop concrete discharge channel along the right abutment. A 20-inch diameter cast-iron pipe passing through the embankment serves as a supply line. Reservoir drawdown control is provided by a 14-inch diameter cast-iron blowoff conduit which parallels the 20-inch supply line. The blowoff conduit is valved on the upstream side within a concrete intake tower (referred to as a vault by the owner's personnel).

At the upstream end of the reservoir is a sedimentation basin and miscellaneous appurtenances which can direct flow (via flash boards) into Reservoir No. 1 and/or into an earth and masonry raceway which can carry part of the inflow around the reservoir.

b. Location. Hutchinson Reservoir Dam No. 1 is located along Redstone Creek in South Union Township, Fayette County, Pennsylvania. The community of Hopwood, Pennsylvania lies immediately downstream while the city of Uniontown is located to the north approximately three miles downstream of

the site. The dam, reservoir and watershed are contained within the Brownfield, Pennsylvania, U.S.G.S. 7.5 minute topographic quadrangle (see Appendix G). The coordinates of the dam are N39° 51.3' and W79° 42.4'.

c. Size Classification. Small (33 feet high, 56 acre-feet storage capacity at top of dam).

d. Hazard Classification. High (see Section 3.1.e).

e. Ownership. Western Pennsylvania Water Company
Uniontown District
72 Coolspring Street
Uniontown, Pennsylvania 15401

f. Purpose. Domestic water supply.

g. Historical Data. This historical account of Hutchinson Reservoir Dam No. 1 is based on sketchy and incomplete state inspection reports available from PennDER files. The best documentation is from the early period, spanning the years 1914 through 1919. The decade of the 1920's is represented by seven inspection reports. Between 1930 and 1950, there are only five reports. From 1950 to present, there is only one cursory report available which was written in 1961.

Based on the above data, Hutchinson Reservoir Dam No. 1 was constructed in 1887 to serve as a water supply reservoir for the city of Uniontown, Pennsylvania. The first reported inspection of the facility was conducted by the Water Supply Commission of Pennsylvania on September 19, 1914. The initial inspection revealed seepage at the toe of the dam near the left abutment and adjacent to the outlet pipe at the toe of the dam. The spillway was also deemed seriously inadequate. Consequently, the water company was directed to enlarge the spillway from a design capacity of 400 cfs to 1170 cfs and to install a weir or weirs to measure the observed seepage. In 1915, the water company responded by modifying the facility which increased the spillway capacity to 990 cfs, but still less than the commission's request.

Inspection reports from 1919 to 1941 recount numerous occurrences of leakage and remedial work, the most pertinent of which are discussed below.

In 1919, a small leak through the embankment appeared near the spillway. This was repaired by backfilling a portion of the clay puddle core. In 1921, a leak developed through the puddle core wall beneath the spillway. This was repaired by excavating the fill materials from beneath the spillway and replacing the clay puddle core wall with a two-foot thick concrete wall, anchored in rock and extending

from the right abutment to the left side of the spillway. At this time, continued seepage was observed at the toe of the dam on the left abutment and at the outlet pipe. Seepage on the left abutment was investigated around 1921-1922 when two borings were drilled from the top of the dam and extended 50 feet below the crest elevation. Subsequent grouting of these holes failed to reduce the flow.

In the spring of 1928, a leak developed near the top of the embankment. A trench was dug on the crest behind the upstream paving to the top of the timber sheeting, which supports the clay puddle core. An effective repair was made by replacing the timber sheeting to a depth of approximately one foot below spillway crest elevation. About the same time this work was in progress, two test pits were dug downstream from the toe of the dam to determine the location of the rock foundation with the idea that at some future date a cutoff wall might be constructed along the upstream toe of the dam. Rock was located in these pits at a depth of 18 feet below the natural ground surface. The 1929 and 1930 inspection reports reiterate the problems of seepage on the left abutment and from around the outlet pipe.

In the fall of 1930, the clay puddle core wall between the vault (see Figure 2) and the spillway was opened to a depth of 20 feet in an effort to stop seepage through the embankment near the left side of the spillway channel.

As a result of the 1933 inspection, the Water and Power Resources Board instructed the owner to raise the embankment on both sides of the spillway as this area was a foot lower than the normal embankment crest elevation. The Board also requested that cracks in the spillway abutment walls be filled with mortar or gunite to prevent saturation of the embankment. In 1934, the reservoir was drained and "work was in progress drilling and grouting the foundation, and tamping clay into the embankment." The work of raising the embankment in compliance with the Board's request was also performed at this time. The 1935 inspection report indicates that repair work on the structure was satisfactorily completed and that most of the leakage had been stopped, although a "sizeable stream" was observed to flow at the outlet pipe.

In 1941, it was determined that seepage from around the outlet pipe was increasing, however, no additional records regarding the outcome of this matter are available. The most recent cursory report, dated July 19, 1961, indicates that no leakage was observed, the general appearance is good and that no maintenance is required.

In 1973, or thereabouts, modifications of the intake structure were made. Specific details regarding these modifications were not made available for review during the

inspection, however, water company officials did say that the screen and screen cleaning mechanism were added to the inlet side of the vault at this time. Furthermore, water company officials indicated that modifications are continually being made to the water treatment facility in an effort to improve service.

1.3 Pertinent Data.

The elevations listed below are based on a recent datum (spillway crest = 1291.8 feet) provided by the owner.

- a. Drainage Area. Local \approx 0.43 sq. miles (Dam No. 1 only)
Total \approx 2.42 sq. miles (Dams 1, 2, and 3, inclusive)

b. Discharge at Dam Site. Discharge records are not available. The owner's representative could not recall with any certainty the maximum spillway discharge to date.

- c. Elevation (feet above mean sea level).

Top of Dam \approx 1294.3 (low point on embankment).

Maximum Design Pool - Not known.

Maximum Pool of Record - Not known.

Normal Pool \approx 1291.8.

Emergency Spillway Crest \approx 1291.8.

Upstream Portal Outlet Invert \approx 1269 (Rough Estimate).

Downstream Portal Outlet Invert \approx 1261 (Rough Estimate).

Streambed at Dam Centerline \approx 1270.

Maximum Tailwater - Not known.

- d. Reservoir Length (miles).

Maximum Pool \approx 0.2 (elevation 1294.3).

Normal Pool \approx 0.2 (elevation 1291.8).

e. Storage (Acre-feet).

Emergency Spillway \approx 46 (elevation 1291.8).

Top of Dam \approx 56 (elevation 1294.3).

Design Surcharge - Not known.

f. Reservoir Surface (Acres).

Normal Pool \approx 4 (elevation 1291.8).

Top of Dam \approx 5 (elevation 1294.3).

Maximum Design Pool - Not known.

g. Dam.

Type - Earth embankment with a clay puddle core and upstream concrete facing.

Length \approx 308 feet.

Height \approx 33 feet (outlet invert to crest).

Side Slopes - Upstream: 1H:1V (exposed freeboard zone field measured).
Downstream: 1.5 H:1V (crest to toe, field measured).

Zoning - None indicated.

Impervious Core - Drawings indicate that the dam is provided with a 2-foot thick clay puddle core wall confined with one-inch thick oak plank. The puddle extends 14 feet below the original ground surface along the centerline section to the top of the dam (see Figure 2).

Cutoff - The puddle core trench serves as the only embankment cutoff. (A 2-foot thick concrete core wall anchored in rock was installed in 1921 to provide cutoff beneath the spillway section.)

Grout Curtain - None indicated, however, historical records imply some remedial grouting was done.

h. Diversion and Regulating Tunnels. None.

i. Spillway.

Type - Uncontrolled concrete rectangular overflow with a multiple vertical drop concrete discharge channel located on the right abutment.

Crest Elevation - 1291.8.

Crest Length - 42 feet (field measured).

j. Outlet Conduits.

1. Supply Pipe - 20-inch diameter, cast-iron; length \approx 110 feet (vault to downstream valve).

Closure - Gate valves in upstream vault and near downstream toe adjacent to water treatment building.

2. Blowoff Pipe - 14-inch diameter, cast-iron; length \approx 110 feet (vault to outlet).

Closure - Gate valve in vault and on upstream extension in small sedimentation basin.

Regulating Facilities - The vault (control tower) is located on the upstream face and contains three gates and/or valves for regulating discharge.

Access - Access to the vault is from the crest of the dam. Other valves are at ground level.

SECTION 2 ENGINEERING DATA

2.1 Design.

a. Design Data Availability and Sources. No design reports are available for any aspects of this facility. Design features, presented below, are derived from two drawings (see Page 1 of 5, Appendix A), available state inspection reports, and discussions with the owner's representatives during the inspection.

b. Design Features.

1. Embankment. Available drawings indicate that the embankment is constructed of earth; however, placement and compaction procedures are unknown. A drawing issued in 1914 (see Figure 2) shows the original configuration. A second drawing issued in 1915 presents typical cross sections and an embankment profile for raising the embankment approximately four feet to increase spillway capacity.

The earliest descriptive report pertaining to the facility was made by the Water Supply Commission of Pennsylvania on September 19, 1914. This report was prepared 27 years following construction and contains data relative to the pertinent dimensions of the original facility. The following excerpt is from this report and presumably describes the condition of the embankment in 1914.

"This dam is an earth embankment with a clay puddle core wall. It is 300 feet long and has a maximum height of 25 feet. The top of the embankment has a width of about 30 feet with a slope of 4 feet in it away from the reservoir. The downstream face has a slope of 1 vertical on 2 horizontal. The upstream face has a slope of 1 on 1-1/2 and is lined with concrete. The clay puddle core wall is in the upstream portion of the embankment. It is 2 feet thick and extends into the foundation to a depth of 14 feet below the original surface of the ground. According to the plan of the reservoir, this wall, for its full height, has 1 inch oak planks on both sides of it."

2. Appurtenant Structures.

a) Outlet Structure and Conduits. The outlet structure (known as a vault) is a rectangular, masonry unit which houses valve mechanisms and a filtration device for the potable water supply. The unit is located to the right of dam center and on the upstream side of the crest

(see Photographs 9 and 10). Winch and pulley assemblies located atop the structure are parts of the screen cleaning and filtration apparatus. A 20-inch diameter cast-iron supply pipe passes from the vault on the upstream side through the embankment to the water treatment building at the downstream toe of the dam. Flow is indirectly regulated at the upstream inlet by a 20-inch diameter gate valve controlling flow into the vault. Just downstream of the water treatment building a 20-inch diameter gate valve is used to control flow to the supply system. Below the downstream gate valve, the 20-inch diameter cast-iron supply pipe extends down the creek channel several hundred feet to a distribution box.

Modifications of the outlet system were made around 1973. Specific details regarding these modifications were not made available for review; however, water company officials did indicate that the screen and manual screen cleaning device (a wire broom) were installed at the 20-inch pipe discharging into the vault.

b) Blowoff. A 14-inch diameter cast-iron pipe passes beneath the entire length of Hutchinson Reservoir No. 1. The valved inlet to this pipe is located in the sedimentation pond at the extreme upstream edge of the reservoir. The pipe passes beneath the reservoir, adjacent to the vault and through the embankment. This line is connected to the vault via a "T" coupling and valve. Blow-off and drawdown can be regulated by the gate valve in the vault. The outlet of the 14-inch diameter blowoff is located immediately downstream of the embankment, adjacent the water treatment building (see Photograph 11).

c) Emergency Spillway. The emergency spillway at this facility is a rectangular concrete chute which discharges into a 4-tiered concrete spillway channel located on the right abutment. At the control section, the concrete channel is approximately 42 feet in width. The length of the control section is approximately 30 feet whereas the total channel length from the inlet to the plunge pool is about 55 feet. Discharge from the spillway enters a plunge pool protected on the right by a sandstone outcropping and on the left by a sandstone block retaining wall.

c. Design Data and Procedures. No design data are available for any aspect of this facility.

2.2 Construction Records.

No construction records are available.

2.3 Operating Records.

No operational records are available.

2.4 Other Investigations.

It is our understanding that the owner has retained the services of a consulting engineer to make a detailed hydraulic and hydrologic evaluation of all three Hutchinson facilities. The owner refused to provide the inspection team with a copy of the consultant's report.

2.5 Evaluation.

No formal engineering data are available; however, sufficient information in the form of drawings and historical records are available which indicate the facility was constructed around 1887 and is of antiquated design.

SECTION 3 VISUAL INSPECTION

3.1 Observations.

a. General. Based on the visual inspection, the structure is considered to be in poor condition. Observations noted during the inspection indicate numerous deficiencies exist at the facility which require immediate maintenance, repair and investigation.

b. Embankment. The general appearance of the embankment suggests that it is in poor condition. Poor horizontal alignment, sinkholes on the crest and on the right abutment, visible movement of the upper portion of the vault and a history of chronic seepage problems raise doubts as to the structural integrity of the embankment. A sinkhole on the crest measuring three feet in depth suggests internal erosion of embankment materials (see Figure 1 and Photograph 4) and movement of the upper portion of the vault (Photograph 10) suggests differential movements within the embankment.

Considerable seepage and ponding was observed in the channel adjacent to the treatment building at the downstream toe of the embankment (see Photograph 11). This area of seepage has been observed for many years.

A sharply defined seepage channel also exists below the dam on the left abutment, however, no free flowing water was observed at the time of the inspection. Seepage observations may not be conclusive as the reservoir was drawn down approximately 3.6 feet below normal pool (spillway crest) at the time of the inspection.

The downstream slope of Hutchinson Reservoir Dam No. 1 is seeded in part by crown vetch. The left half of the slope is partially covered with grass, weeds, and shrubbery. The crest of the embankment is protected with a well established grass cover. The upstream slope of the embankment is lined with concrete. Although numerous horizontal and vertical cracks are apparent, the observed portion of the lining above the water line appears to be intact.

c. Appurtenant Structures.

1. Outlet Structure and Conduits. As indicated in Photograph 10, the outlet structure has apparently rotated and cracked from differential movements in the upstream slope of the embankment. Valve stems and miscellaneous mechanical devices atop the structure are well

maintained and, according to the owner's representative, reportedly are functional. All pipes and valves are submerged and not visible.

2. Spillway. Visual inspection found the spillway to be in fair condition. The flow surface (see Photograph 5) is good throughout, however, the sidewalls are deteriorated, exhibiting many cracks. The sandstone block retaining wall at the bottom left of the spillway channel is in good condition.

d. Reservoir. The slopes surrounding the reservoir are heavily wooded and steep with no apparent signs of slope distress. Sedimentation, observed due to the subnormal pool level, does not appear significant (see Photograph 7).

e. Downstream Channel. Hutchinson Reservoirs Nos. 1, 2 and 3 occur in tandem within the Redstone Creek valley. As shown on the Overview Photograph, Reservoir No. 1 is the lowermost of the three Hutchinson reservoirs (see Regional Vicinity Map, Appendix G). All three of the structures are located just upstream of the communities of Hutchinson and Hopwood, each having many residences and apartment buildings on the Redstone Creek floodplain (see Photograph 13).

The total number of residences which could be affected by a breach of Hutchinson Reservoir Dam No. 1 exceeds 20.

Because of the above mentioned considerations, the facility was given a "high" hazard rating.

3.2 Evaluation.

Observations made during the visual inspection suggest that the overall condition of the facility is poor. This conclusion is based on a variety of deficiencies that include: 1) evidence of movement of the upper portion of the vault; 2) ponding and seepage at the downstream toe of the facility; 3) a sinkhole on the crest of the embankment; and 4) poor horizontal alignment of the crest.

SECTION 4 OPERATIONAL PROCEDURES

4.1 Normal Operating Procedure.

According to the owner's representatives, there are no formal operating procedures detailed in manual form that pertain to the operation of this facility. Discharge to the supply system can be regulated below the water treatment building by the 20-inch diameter gate valve. Flow into the vault is controlled by a 20-inch diameter gate valve on the inlet side of the vault. The inlet to this pipe is covered with a fine mesh wire screen. On top of the vault, a pulley device manually operates a wire broom which clears debris from the face of the screen. The 20-inch diameter supply line passing through the embankment is also covered with a fine wire mesh screen on the inlet end within the vault. In addition to the screen, a wooden box over the screen is periodically filled with excelsior to provide additional filtration.

Drawdown is controlled by operating the 14-inch diameter gate valve on the 14-inch diameter cast-iron pipe passing beneath the reservoir and embankment. Water entering the vault can be diverted into the 14-inch diameter line for complete reservoir drawdown. The outlet of the blowoff conduit is located adjacent to the water treatment building at the downstream toe of the dam. The valves are operated by the resident dam tender upon orders of water company officials.

4.2 Maintenance of Dam.

There are no formal maintenance procedures at the dam. General maintenance is provided by the resident dam tender on an unscheduled basis.

4.3 Maintenance of Operating Facilities.

Other than occasionally operating the gate valves, no regular maintenance is performed on the operating mechanisms.

4.4 Warning Systems.

There are no formal warning systems in effect at this facility. The water company has authored a publication entitled, "Emergency Plan to Maintain Safe Potable Water Delivery to Consumers of WPWCO." The plan includes a listing

of local radio stations, police and fire, etc. The plan itself makes no provisions for a flood emergency warning system, but could easily be modified to include one. Currently, the resident dam tender is charged with the responsibility of informing the proper authorities in the event of an emergency.

4.5 Evaluation.

The facility is operated by a resident dam tender although no formal operations and maintenance manuals are available. There is no formal warning system in effect to protect downstream residents in the event of an emergency; however, the written emergency plan for safe water supply could be adapted for such use.

SECTION 5 HYDROLOGIC/HYDRAULIC EVALUATION

5.1 Design Data.

No original design data are available. The water company has reportedly retained a consulting engineer to investigate the hydraulic adequacy of the structure. Details of this investigation were not made available to the inspection team.

5.2 Experience Data.

No records of discharge data are available at the facility.

5.3 Visual Observations.

On the date of inspection, no conditions were observed that would indicate that the outlet pipe and spillway would not operate satisfactorily within the limits of their design during a flood event.

5.4 Method of Analysis.

The facility has been analyzed in accordance with the procedures and guidelines established by the U. S. Army Corps of Engineers, Baltimore District, for Phase I hydrologic and hydraulic evaluations. The analysis has been performed utilizing a modified version of the HEC-1 program developed by the U. S. Army Corps of Engineers, Hydrologic Engineering Center, Davis, California.

The Modified HEC-1 Program is capable of performing two basic types of hydrologic analyses: (1) the evaluation of the overtopping potential of the dam; and (2) the estimation of the downstream hydrologic-hydraulic consequences resulting from assumed structural failures of the dam. The computational procedures typically used in the dam overtopping analysis are as follows:

- a. Development of an inflow hydrograph(s) to the reservoir.
- b. Routing of the inflow hydrograph(s) through the reservoir to determine if the event(s) analyzed would overtop the dam.

- c. Routing of the outflow hydrograph(s) from the reservoir to desired downstream locations. The results provide estimates of the peak discharge, time of the peak discharge, and the maximum stage of each routed hydrograph at the downstream end of each reach.

The evaluation of the hydrologic-hydraulic consequences resulting from an assumed structural failure (breach) of the dam is typically performed as follows:

- a. Development of an inflow hydrograph(s) to the reservoir.
- b. Routing of the inflow hydrograph(s) through the reservoir.
- c. Development of a failure hydrograph(s) based on specified breach criteria and normal reservoir outflow.
- d. Routing of the failure hydrograph(s) to desired downstream locations. The results provide estimates of the peak discharge(s), time(s) to peak and maximum water surface elevation(s) of the failure hydrograph(s) for each location.

5.5 Summary of Analysis.

a. Spillway Design Flood (SDF). In accordance with procedures and guidelines contained in the National Guidelines for Safety Inspection of Dams for Phase I Investigations, the SDF for this facility ranges between the 1/2 PMF (probable maximum flood) and the PMF based on the relative size (small) and hazard potential (high) of Hutchinson Reservoir Dam No. 1. Due to the extensive downstream hazard potential and the requirements of the upstream reservoirs, the SDF for this facility is considered to be the PMF.

b. Results. Although this report deals specifically with the analysis of Hutchinson Reservoir Dam No. 1, the effects of the upstream Reservoir Dams Nos. 2 and 3 were also considered since they presently control the inflows into Reservoir No. 1. The dams were investigated such that Reservoir No. 3 was initially empty (as has been the case since 1974), and Reservoirs Nos. 1 and 2 were initially at their normal pool or emergency spillway elevations (although at the time of inspection both reservoirs were partially drawn down). The effects of the existing raceways around Reservoirs Nos. 1 and 3 on inflows and outflows were taken into account via the discharge rating curves of the respective

dams (Appendix C, Sheets 10-13 of 17; and Appendix C-1, Sheets 14-15 of 15). Also, the actual estimated storage-elevation relationship of Reservoir No. 2 was modified in order to compensate for the discharge over the left bank of its dam into an adjacent watershed which occurs once the dam is overtopped (Appendix C-1, Sheets 24-29 of 29). All pertinent engineering calculations relative to the analysis of the Hutchinson Dams System are provided in Appendices C and C-1.

Overtopping Analysis (using the Modified HEC-1 Computer Program) of the dams in series indicated that the emergency spillway(s) of each dam could discharge only a small fraction of the PMF prior to overtopping. In particular, Dam No. 3 passed approximately 37 percent of the PMF before overtopping, Dam No. 2 passed about 27 percent of the PMF, and Dam No. 1 passed approximately 33 percent of the PMF (Appendix C, Summary Input/Output Sheets). Analyzed individually, the spillways of Dams Nos. 1 and 2 would be less adequate than stated above, since the effect of an upstream impoundment on a downstream reservoir is to attenuate the potential inflows into, and thus the outflows from the downstream reservoir. Therefore, if Dams Nos. 2 and 3 were ignored in the analysis or removed from the system, the overtopping of Dam No. 1 would occur at a lower percentage of the PMF than reported above. In either case, Dam No. 1, as well as Dams Nos. 2 and 3, has a high potential for overtopping, and thus for breaching, due to its structural condition (see Section 6 for the structural evaluation of Dam No. 1).

Since none of the three dam facilities of the system could safely pass at least a flood of 1/2 PMF magnitude (the SDF on each of the dams is the full PMF), the possibility of failure of each of the dams under 1/2 PMF conditions was investigated (in accordance with ETL-1110-2-234). It must, however, be understood that it is difficult, if not impossible, to determine exactly how or if a specific dam will fail. Therefore, several possible alternatives were investigated. Again, the dams were evaluated in series so as to ascertain the overall effect of the present system on the downstream population in the event of a severe storm.

The Modified HEC-1 Program was used to generate the possible results of dam breaching due to downcutting by the overtopping waters. Breaching due to piping could not be analyzed directly.

It was assumed, for the purpose of analysis, that breaching would begin once the reservoir water level reached the top of dam elevation of each of the dams. This assumption was based on the opinion that any amount of overtopping

can potentially fail an earth dam, since there are so many unknowns that can contribute to the failure process, and in the particular case of the Hutchinson dams, all are of questionable structural integrity. Breaching the dams at their respective top of dam elevations yields minimum downstream consequences due to failure under 1/2 PMF conditions since, the volumes of water behind the dams will be at a minimum when failure begins (if one assumes that a dam would not fail unless overtopped). However, failure of any of the dams could occur prior to overtopping due to the structural conditions of the dams. That is, failure of each of the dams due to piping under higher than normal heads is a possibility. Dams Nos. 2 and 3 have concrete core walls which may be considered to add to the overall stability of the dams when overtopped. Dam No. 2 is, however, visibly misaligned and replete with structural irregularities and a history of seepage problems. All of these deficiencies suggest that the integrity of the present corewall at Dam No. 2 is questionable. Similarly Dam No. 3 is beset by problems the extent of which have prompted the owner to maintain the reservoir drained indefinitely until further studies of its present structural integrity can be completed. An additional overall assumption was that the breach sections would propagate downward to depths equal to the heights of the respective dams (56 feet for Dam No. 3, 47 feet for Dam No. 2, and 33 feet for Dam No. 1), since the impounded streams should tend to seek the previous equilibrium levels which they had attained prior to the construction of the dams (if at all possible).

Two sets of breach section geometry were evaluated for each of two failure times (Appendix C, Sheets 14-15 of 17). The two sets of breach sections chosen were considered to be the minimum and maximum probable failure sections. The minimum section for each dam was triangular in shape with very steep side slopes (1/2H to 1V) and a zero bottom width. The maximum section for each dam was trapezoidal in shape with side slopes representative of the estimated side slopes of the valley walls adjacent to the individual dams, and bottom widths equal to the estimated valley widths along the center lines of the individual dams. The two failure times (total time for each breach section to reach its final dimensions) under which the minimum and maximum sections were investigated were assumed to be near instantaneous (15 minutes) and prolonged (4 hours), so that the possible lower and upper limits of this most sensitive variable might be evaluated. The near instantaneous failure time was thought to be realistic if the concrete core walls of Dams Nos. 2 and 3 were indeed in poor condition and/or major piping channels developed prior to and during the early stages of downcutting. The near instantaneous time of

failure could also apply if the concrete core walls of Dams Nos. 2 and 3 were truly in good condition, and could support the respective structures while the downstream toes of the dams were eroded away by the overtopping waters. In such cases, failure by instantaneous overturning of the concrete core walls could occur. The prolonged failure time was thought to be on the optimistic side (with respect to the dams), but still possible at least for Dams Nos. 2 and 3 if their concrete core walls were actually only in fair condition (some cracks). In these cases, the downcutting of the dams would probably be controlled by the slow rates at which the concrete core walls could be broken up and removed in chunks.

In addition to the above breach conditions, an average or more probable set of conditions was analyzed. These conditions were such that the breach sections were defined by side slopes of 1H to 1V and bottom widths intermediate to the minimum and maximum breach widths previously stated. The failure times for Dams Nos. 2 and 3 were assumed to be longer (2 hours) than that for Dam No. 1 (1 hour) due to the probable resistance of their concrete core walls to quick downcutting. The clay puddle core of Dam No. 1 should offer no such resistance.

Regardless of the assumed breach geometry or failure times (and under the "top of dam" initial breaching elevation assumption), the dams always breached in the same sequence. That is, Dam No. 1 failed first, and was followed some time later (about 2 hours) by the failure of Dam No. 2, which was followed a short time later (about 5 minutes) by the failure of Dam No. 3 (Appendix C, Sheet 16 of 17). Further, the same ultimate results were obtained for each set of breaching conditions. Simply stated, the failure of one or more of the dams of the system will significantly increase the estimated non-breach downstream water surface elevations, and thus, the probability of additional loss of life and property damage. A supplementary consequence of the system is that the possible failure of an upstream dam prior to overtopping (for reasons mentioned previously) will most probably cause the failure of a downstream dam.

The near instantaneous failures produced the largest peak outflows and corresponding downstream water surface increases, while the optimistic (with respect to the dam) prolonged failures resulted in much smaller, although still significantly high, relative peak outflows and downstream water surface increases (Appendix C, Sheets 16-17 of 17).

The average or more probable mode of failure provided peak breach discharges of 6000 cfs, 7700 cfs, and 8100 cfs from Dams Nos. 3, 2, and 1, respectively. Downstream water

surfaces increased by 5.7 feet (above the maximum 1/2 PMF water surface elevation) at a section located 250 feet downstream of Dam No. 1, and by 5.8 feet (above the same datum) at a section located about 1500 feet downstream. Even when the system of dams was analyzed such that breaching would not begin until the dams were overtopped by six inches of water, the same approximate system results were obtained for the more probable type of failure (Appendix C, Sheets 16 and 17 of 17, Plan 6). The only major differences between the two sets of results analyzed, was that for the 6-inch failure criterion analyzed, all of the dams failed within 15 minutes of each other. In any event, as can be seen on the Regional Vicinity Map (Appendix G), the many homes located on the floodplain immediately below the dams would be significantly affected by the dam failures, especially if one considers not only the increase in the height of the breach floodwave, but also the increased momentum that the larger and probably swifter moving volume of water would possess.

Although Reservoir No. 1 is presently only a part of a larger system and was analyzed as such, some approximations can be inferred from the system results as to the downstream effects of the "removal" (by way of estimating and eliminating the increased Dam No. 1 outflows due to upstream breaching) of one or both of the upstream dams. If, perhaps Reservoir No. 3 was "removed" from the present system, the specific result of the combined failures of Dams Nos. 1 and 2 would be to raise the maximum 1/2 PMF water surface elevation at the section located 1500 feet below Dam No. 1 by about 3 feet according to the more probable breach analysis. This increase in water surface was determined via the interpolated water surface elevation corresponding to the estimated maximum Dam No. 2 breach outflow of 3600 cfs. The 3600 cfs flow was approximated as the largest difference between the actual computed breach outflows from Dam No. 2 and the estimated Dam No. 3 contributions to the Dam No. 2 outflows. Since Dam No. 1 fails about 2 hours before Dam No. 2, it will have reached its maximum breach dimensions prior to the inflow of the 3600 cfs and will cause very little attenuation of the flow. If both Dams Nos. 2 and 3 were "removed" from the system, the immediate results of the failure of Dam No. 1 alone would be to increase the base elevation at the most downstream section by about 0.2 feet based on the more probable breach analysis. This increase was determined via the interpolated water surface elevation corresponding to the maximum Dam No. 1 breach outflow of 1750 cfs (which occurs prior to the failures of Dams Nos. 1 and 2). Although this slight increase in the downstream water surface might not seem to be significant, the increases resulting from the two possible near instantaneous failure conditions are significant. In particular, the increase in

the base elevation resulting from a near instantaneous breach of Dam No. 1 with minimum section dimensions would be about 1.7 feet (based on the maximum breach outflow of 2950 cfs), and that with maximum section geometry would be about 3.5 feet (based on the maximum breach outflow of 4640 cfs). These breach outflows were unaffected by the failures of Dams Nos. 2 and 3. Therefore, whether considered alone or, more correctly, as a part of the existing system, the failure of Dam No. 1 is highly possible and will most probably lead to increased loss of life and property damage in the downstream communities.

5.6 Spillway Adequacy.

As presented previously, under existing conditions Hutchinson Reservoir Dam No. 1 can safely pass approximately 33 percent of the PMF prior to overtopping. Should a 1/2 PMF-size event occur, the dam will be overtopped and, in all probability, will subsequently fail, endangering the population of the downstream communities. Therefore, the spillway system of Hutchinson Reservoir Dam No. 1 is deemed seriously inadequate.

SECTION 6 EVALUATION OF STRUCTURAL INTEGRITY

6.1 Visual Observations.

a. Embankment. Based on the visual inspection, the embankment appears to be in poor structural condition. Seepage near the outlet pipe continues despite efforts in the past to control it. The upstream face of the dam is cracked and very irregular. A sinkhole is evident in the crest of the embankment to the left of the gate house.

b. Appurtenant Structures. Based on the visual inspection, the remainder of the facility appeared to be in fair condition. The concrete spillway surface showed no evidence of significant deterioration or damage although the spillway walls exhibited numerous cracks. The upper portion of the valve chamber, as shown in Photograph 10, has rotated, possibly from movements within the embankment. The outlet works could not be observed closely as both conduits were buried or submerged. The outlet of the 14-inch diameter blowoff conduit was submerged in a pool formed by seepage at the downstream toe of the embankment (see Photograph 11). Below the dam, the water treatment building, chemical storage shed, a 20-inch diameter supply line valve pit, and related facilities are in good condition. The inlet control mechanisms and screen clearing device are reportedly in good working order.

6.2 Design and Construction Techniques.

No records are available detailing the methods of design and construction.

6.3 Past Performance.

No formal records of past performance are available from the owner; however, historical accounts and inspection reports available from PennDER files recount a history of seepage (possibly piping) and remedial work. These included grouting, installation of a section of concrete cut-off wall and several attempts to replace sections of the clay puddle core. Field inspection revealed an irregular upstream crest, a sinkhole in the crest, and seepage or evidence of seepage in previously recorded areas, with the pool level below the spillway crest approximately 3.6 feet. In summary, the available information and field inspection indicate a history of poor past performance.

6.4 Seismic Stability.

The dam is located in Seismic Zone No. 1 and is thus subject to minor earthquake induced forces. Since no records of construction materials or techniques are available and since the structure has a history of excessive seepage both beneath and through the embankment, it is possible that even minor earthquake induced dynamic forces could be significant at high pool levels. However, no investigations or calculations were performed to confirm this opinion.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS FOR REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The visual inspection, operational history and hydrologic and hydraulic analysis indicate that the structure is in poor condition. Apparent rotation of the outlet structure, unevenness of the upstream face and a sinkhole in the crest suggest possible internal piping problems which are possibly active under normal pool conditions. Records of past performance show numerous problems related to seepage both under and through the embankment during its 91 year life span.

Hydrologic and hydraulic calculations indicate that the existing reservoir and spillway system will pass only 33 percent of the PMF before overtopping occurs. Under 1/2 PMF conditions, it has been determined that the embankment will be overtopped leading to failure and a significant increase in the hazard to loss of life downstream. As the facilities hazard rating is "high", the present spillway condition is assessed as being seriously inadequate.

The inadequacies of the spillway and evidence of possible internal piping are deficiencies of such a nature that if left uncorrected could result in the failure of the dam with subsequent loss of life and/or substantial property damage. Thus, the facility is considered unsafe. Failure does not appear imminent under the conditions which existed at the time of inspection; however, a detailed emergency operation plan and warning system should be immediately activated which includes around-the-clock surveillance during periods of unusually heavy precipitation by a registered professional engineer experienced in the design and performance evaluation of earth structures.

b. Adequacy of Information. The available data are considered sufficient to make an accurate assessment of the facility. A detailed hydrologic and hydraulic evaluation of all three Hutchinson facilities has reportedly been prepared by a consultant retained by the owner. This report was not made available for review and could possibly aid to more accurately evaluate the facilities.

c. Urgency. Detailed evaluation of the facility and implementation of an emergency operation plan, warning system, and around-the-clock surveillance during intense storms should be initiated immediately.

d. Necessity for Additional Investigation. The owner should initiate the following investigations:

1. A subsurface investigation to determine the condition and engineering properties of the embankment materials and an assessment of causes of sinkhole development in the crest.

2. A hydrologic and hydraulic evaluation including effects on downstream developments if the facility is breached or removed from the system which includes Hutchinson Reservoir Dams Nos. 1, 2, and 3.

7.2 Recommendations/Remedial Measures.

a. Facilities. It is recommended that the owner:

1. Perform a detailed hydrologic and hydraulic evaluation of the facility including an assessment of downstream effects from breaching or removing the embankment from the system which includes Hutchinson Reservoir Dams Nos. 1, 2, and 3.

2. Perform a detailed subsurface evaluation to determine the cause of sinkhole development in the crest and the in-situ properties of the embankment materials.

3. Perform a stability and seepage evaluation of the embankment under all possible operating conditions utilizing the results of Item 2 above.

4. Determine the extent of apparent structural distress in the outlet structure.

5. Take appropriate remedial actions based on the results of the above analyses.

b. Maintenance and Operating Procedures. It is recommended that the owner:

1. Immediately activate a plan for emergency operation and a warning system for downstream residents. Included in the plan should be provisions for around-the-clock surveillance of the facility by a professional engineer experienced in the design and performance evaluation of earth structures during periods of unusually heavy precipitation.

2. Inspect the facility on a daily basis to determine if the sinkhole development in the crest is an active process requiring immediate remedial action. Particular attention should be given to the seepage at the outlet

conduit and the apparent seepage near the toe of the left abutment. This area should also be cleared of all brush and debris to facilitate daily inspection.

3. Monitor apparent movement of the outlet structure.

APPENDIX A
CHECK LIST - ENGINEERING DATA

NAME OF DAM: Hutchinson Reservoir Dam No. 1 CHECK LIST
ENGINEERING DATA
PHASE I

PAGE 1 OF 5

NDI#: PA-214 PENNDER#: 26-13

| ITEM | REMARKS | NDI# PA - 214 |
|--|---|---------------|
| PERSONS INTERVIEWED AND TITLE | William McAdams (Engineer) - Western Pennsylvania Water Company John Orlando (Superintendent) Western Pennsylvania Water Company | |
| REGIONAL VICINITY MAP | See Appendix G U.S.G.S. 7.5 minute series quadrangle, Brownfield, Pennsylvania, dated 1964 and photorevised in 1973. | |
| CONSTRUCTION HISTORY | Inferred from PennDER correspondence and conversations with the dam owner's representatives. See Section 1.2.g of this report. | |
| AVAILABLE DRAWINGS | Cross-section and profile drawing dated August 1914, entitled "Union- town Water Company Hutchinson Reservoir No. 1" (see Figure 2, Appendix F). Also, drawing dated June, 1915, entitled "Alignment and X-section Map of Proposed Improvement at Hutchinson Reservoir No. 1" (see Figure 3, Appendix). Both drawings by W.S. McClay, Uniontown, PA, available from PennDER. | |
| TYPICAL DAM SECTIONS | See Figure 2, Appendix F. | |
| OUTLETS: PLAN DETAILS DISCHARGE RATINGS | See Figure 2, Appendix F | |

ENGINEERING DATA (CONTINUED)

PAGE 2 OF 5

| ITEM | REMARKS | NDI# PA - 214 |
|---|---------------------------|---------------|
| SPILLWAY: PLAN SECTION DETAILS | See Figure 2, appendix G. | |
| OPERATING EQUIPMENT PLANS AND DETAILS | None available. | |
| DESIGN REPORTS | None available. | |
| GEOLOGY REPORTS | None available. | |
| DESIGN COMPUTATIONS: HYDROLOGY AND HYDRAULICS STABILITY ANALYSES SEEPAGE ANALYSES | None available. | |
| MATERIAL INVESTIGATIONS: BORING RECORDS LABORATORY TESTING FIELD TESTING | None available. | |

ENGINEERING DATA (CONTINUED)

PAGE 3 C. 5

| ITEM | REMARKS |
|---|--|
| BORROW SOURCES | Unknown. |
| POST CONSTRUCTION DAM SURVEYS | Study prepared by Burgess by Niple, Consulting Engineers, Columbus, Ohio, dated 1973 is reportedly available from the owner. Access to this information was denied the inspection team by the owner. |
| POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS | See above. |
| HIGH POOL RECORDS | Elevation of highest pool to date is not known. According to the owner's representatives, none of the Hutchinson Reservoir Dams have ever overtopped. |
| MONITORING SYSTEMS | None. |
| MODIFICATIONS | Intake structure modified sometime around 1973. According to the owner's representatives no drawings and/or design data are available pertaining to this modification. |

| ITEM | REMARKS | NDI# - PA 214 |
|---|---|---------------|
| PRIOR ACCIDENTS OR FAILURES | None. | |
| MAINTENANCE: RECORDS MANUAL | Maintenance records are not kept for this facility. No formal maintenance manual is available. | |
| OPERATION: RECORDS MANUAL | Pool elevation, daily discharge, or operational records are not kept for this facility. No formal operation manual is available. | |
| OPERATIONAL PROCEDURES | There are no formal operational procedures associated with this facility. Excess inflow is discharged through the emergency spillway. The outlet works are operated manually by the resident dam tender upon orders from the owner. | |
| WARNING SYSTEM AND/OR COMMUNICATION FACILITIES | There are no formal warning systems or emergency procedures presently in effect. A full-time caretaker resides near the facility just downstream of Hutchinson Reservoir Dam No. 2 and is responsible to take whatever steps are necessary to warn downstream residents in the event of an emergency. | |
| MISCELLANEOUS | | |

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

NDI ID # PA-214
PENN DER ID # 26-13
PAGE 5 OF 5

SIZE OF DRAINAGE AREA: Local = .043 sq. mi.; Total = 2.42 sq. mi.

ELEVATION TOP NORMAL POOL: 1291.8 STORAGE CAPACITY: 46 ac-ft.

ELEVATION TOP FLOOD CONTROL POOL: - STORAGE CAPACITY: -

ELEVATION MAXIMUM DESIGN POOL: - STORAGE CAPACITY: -

ELEVATION TOP DAM: 1294.3 STORAGE CAPACITY: 56 ac-ft.

SPILLWAY DATA

CREST ELEVATION: 1291.8.

TYPE: Concrete channel

CREST LENGTH: 42 feet

(Measured from upstream embankment face
CHANNEL LENGTH: 30 feet. to the edge of the first vertical drop
in the discharge channel)

SPILLOVER LOCATION: Right abutment.

NUMBER AND TYPE OF GATES: None.

OUTLET WORKS

TYPE: 14-inch CIP blowoff.

LOCATION: Left of emergency spillway.

ENTRANCE INVERTS: 1269 (rough estimate)

EXIT INVERTS: 1261 (rough estimate)

EMERGENCY DRAWDOWN FACILITIES: Valved at intake.

HYDROMETEOROLOGICAL GAGES

TYPE: Rain gage

LOCATION: Between Dam Nos. 1 and 2.

RECORDS: Daily records available at owner's Uniontown office.

MAXIMUM NON-DAMAGING DISCHARGE: Not known.

APPENDIX B
CHECK LIST - VISUAL INSPECTION

CHECK LIST
VISUAL INSPECTION
PHASE 1

NAME OF DAM Hutchinson Reservoir Dam No.1 STATE Pennsylvania COUNTY Fayette

NDI# PA - 214 PENNDER# 26-13

TYPE OF DAM Earth SIZE Small HAZARD CATAGORY High

DATE(S) INSPECTION 6 October 1978 WEATHER overcast w/ occasional light drizzle TEMPERATURE 50° @ 1:00 ~~PM~~ PM

POOL ELEVATION AT TIME OF INSPECTION 1288.2 M.S.L.

TAILWATER AT TIME OF INSPECTION N/A M.S.L.

| INSPECTION PERSONNEL | OWNER REPRESENTATIVES | OTHERS |
|------------------------|-----------------------|---------|
| <u>B. M. Mihalcin</u> | <u>W. McAdams</u> | <u></u> |
| <u>J. P. Nairn</u> | <u>J. Orlando</u> | <u></u> |
| <u>S. R. Michalski</u> | <u></u> | <u></u> |
| <u>G. R. Thiers</u> | <u></u> | <u></u> |
| <u>K. H. Khilji</u> | <u></u> | <u></u> |
| <u>D. L. Bonk</u> | <u></u> | <u></u> |

RECORDED BY B. M. Mihalcin

EMBANKMENT

PAGE 2 OF 8

| ITEM | OBSERVATIONS AND/OR REMARKS | NDI# PA - 214 |
|--|--|---------------|
| SURFACE CRACKS | None observed. | |
| UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE | None observed. | |
| SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES | Left side of the embankment near the abutment displays irregularities that are possibly attributable to past erosion. Presently, this particular area is poorly maintained and overgrown. Substantial amounts of debris laden fill have been dumped in this area for no readily apparent reason. | |
| VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST | Vertical - good; maximum observed settlements do not exceed 1-foot horizontal - irregular; particularly evident along the upstream face. Embankment crest is sloped 10 percent upstream to downstream. | |
| RIPRAP FAILURES | No riprap. Upstream slope is faced with concrete that is extensively cracked and irregular. | |
| JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM | O.K. - No noticeable problems. | |

EMBANKMENT

PAGE 3 OF 8

| ITEM | OBSERVATIONS AND/OR REMARKS | NDI# PA - 214 |
|---|--|---------------|
| DAMP AREAS IRREGULAR VEGETATION (LUSH OR DEAD PLANTS) | <p>No damp areas were observed along the downstream embankment face, however, the pool was found to be substantially lower than normal on the day of the inspection.</p> <p>The left side of the embankment and toe area immediately beyond are not maintained to the same degree as the rest of the embankment. The area is generally overgrown and debris laden.</p> | |
| ANY NOTICEABLE SEEPAGE | <p>Possible evidence of past seepage was observed along the downstream toe near the left abutment. Although no seepage was observed during the inspection, the area was found in a damp condition. In addition, a significant amount of fine material was observed below the fallen trees and brush. Perhaps seepage would be evident at higher pools.</p> | |
| STAFF GAGE AND RECORDER | None. | |
| DRAINS | 4-inch diameter tile drain observed at toe of spillway. | |
| SINKHOLES | <p>A sinkhole is located along the embankment crest approximately 50 feet to the left of the intake structure. The origin of this sinkhole is not known, however, it may be associated with a piping problem. A second, smaller sinkhole was discovered located along the right shoreline several feet upstream of the embankment between the reservoir and raceway.</p> | |
| | | |

OUTLET WORKS

| ITEM | OBSERVATIONS AND/OR REMARKS | NDI# PA - |
|--|--|-----------|
| INTAKE STRUCTURE | Masonry structure in poor condition; top 6 feet has rotated as a unit and is visibly misaligned. Referred to as a vault by the owner's representatives, the intake structure houses valve mechanisms for the blowoff and supply lines and a filtration device for the potable water supply. The unit is located to the right of dam center along the upstream face of the embankment. | |
| OUTLET CONDUIT (CRACKING AND SPALLING OF CONCRETE SURFACES) | No concrete surfaces of outlet conduit are exposed. The discharge end of the outlet conduit was submerged when encountered by the field team during the inspection. The inundation could be the result of seepage in or around the conduit. Although no discernable seepage was observed, information available from PennDER files show that the problem had been previously reported by state inspectors. | |
| OUTLET STRUCTURE | 14-inch diameter cast-iron pipe discharges at the downstream toe to the right of embankment center. The conduit was submerged on the day of the inspection by several inches of water and was not readily observed. A 20-inch diameter cast-iron supply pipe reportedly passes from the vault, through the embankment, to the water treatment building at the downstream toe of the embankment. | |
| OUTLET CHANNEL | Natural streambed. | |
| GATE(S) AND OPERATIONAL EQUIPMENT | The blowoff conduit is valved at the intake structure located along the upstream face of the embankment to the left of the spillway. The owner reports the valves to be functional, however, they were not operated in the presence of the inspection team. The supply line is regulated within the vault by two 20-inch diameter gate valves controlling flow into and out of the structure. There is also a 20-inch diameter gate valve on the line just downstream of the water treatment building. | |

EMERGENCY SPILLWAY

PAGE 5 OF 8

| ITEM | OBSERVATIONS AND/OR REMARKS | NDI# PA - 214 |
|-----------------------------------|---|---------------|
| TYPE AND CONDITION | Concrete channel in fair condition. | |
| APPROACH CHANNEL | N/A | |
| SPILLWAY CHANNEL AND SIDEWALLS | Channel floor is in good condition. Sidewalls are in poor condition with many cracks in evidence. | |
| STILLING BASIN PLUNGE POOL | None. | |
| DISCHARGE CHANNEL | Rectangular channel with floor and sidewalls constructed of concrete. Discharge is passed over four vertical drops before reaching the stream at the downstream embankment toe. | |
| BRIDGE AND PIERS | A 3-foot high wood plank bridge spans the spillway channel a few feet downstream of the crest. The bridge is supported by five angle frames spaced at approximate 8-foot intervals. | |
| EMERGENCY GATES | None. | |

SERVICE SPILLWAY

PAGE 6 OF 8

NDI# PA - 214

OBSERVATIONS AND/OR REMARKS

ITEM

TYPE AND CONDITION

N/A

APPROACH CHANNEL

N/A

OUTLET STRUCTURE

N/A

DISCHARGE CHANNEL

N/A

INSTRUMENTATION

PAGE 7 OF 8

NDI# PA - 214

| ITEM | OBSERVATIONS AND/OR REMARKS |
|--------------------------|-----------------------------|
| MONUMENTATION SURVEYS | None. |
| OBSERVATION WELLS | None. |
| WEIRS | None. |
| PIEZOMETERS | None. |
| OTHERS | |

RESERVOIR AREA AND DOWNSTREAM CHANNEL

PAGE 8 OF 8

| ITEM | OBSERVATIONS AND/OR REMARKS | NDI# PA -214 |
|---|--|--------------|
| SLOPES: RESERVOIR | Steep and heavily forested. | |
| SEDIMENTATION | Significant sedimentation was observed along the upstream reaches of the reservoir. | |
| DOWNSTREAM CHANNEL (OBSTRUCTIONS, DEBRIS, ETC.) | 175-foot wide valley. Sides slopes are heavily forested while the bottom has been substantially cleared and developed. | |
| SLOPES: CHANNEL VALLEY | Steep and heavily forested. | |
| APPROXIMATE NUMBER OF HOMES AND POPULATION | Portions of the communities of Hutchinson and Hopwood are located along the floodplain just downstream of the reservoir. At least 20 homes could easily be affected by a breach of Hutchinson Reservoir Dam No. 1. Population - 60-80. | |
| | | |

APPENDIX C
HYDROLOGY AND HYDRAULICS

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR N^o 1
BY DLB DATE 10-24-78 PROJ. NO. 78-617-214
CHKD. BY WJV DATE 1/9/79 SHEET NO. 1 OF 17



DAM LOCATION - BROWNFIELD QUADRANGLE, FAYETTE COUNTY,
PENNSYLVANIA; U.S.G.S. 7.5 MINUTE SERIES,
(TOPOGRAPHIC) PHOTO REVISED 1973

DAM STATISTICS

MAXIMUM HEIGHT - 33 FEET (FIELD MEASURED)

DRAINAGE AREA - 0.43 SQ. MI. (PLANIMETERED OFF U.S.G.S.
BROWNFIELD QUADRANGLE)

STORAGE CAPACITY -

@ NORMAL POOL (EL 1291.8) \approx 45 AC-FT (SEE NOTE BELOW)
@ TOP OF DAM (EL 1294.3) \approx 56 AC-FT (SHEET 5)

SIZE CLASSIFICATION

DAM SIZE - SMALL (REF 1; TABLE 1)

HAZARD RATING - HIGH (FIELD OBSERVATION: REF 1; TABLE 2)

REQUIRED SDF - $\frac{1}{2}$ PMF TO PMF (REF 1; TABLE 3)

NOTE: THE VALUE OF STORAGE CAPACITY IS TAKEN FROM AN
UNPUBLISHED NOTEBOOK CONTAINING PERTINANT DATA
FOR DAMS OPERATED BY THE UNIONTOWN BRANCH OF
W.P.W.. THE NOTEBOOK IS AVAILABLE FROM THE FILES
LOCATED AT THE UNIONTOWN OFFICE OF W.P.W..

SUBJECT

DAM SAFETY INSPECTION.HUTCHINSON RESERVOIR # 1CHKD. BY KHKDATE 10-11-78PROJ. NO. 78-617-214CHKD. BY RFVDATE 10-13-78SHEET NO. 2 OF 17Engineers • Geologists • Planners
Environmental SpecialistsHUTCHINSON RESERVOIR # 1DRAINAGE AREA:

LOCAL = 0.43 SQ. MILE

U.S.G.S MAP

BROWNFIELD QUAD.

PENNSYLVANIA.

TOTAL = 1.9 + .09 + .43

= 2.42 SQ. MILES.

SURFACE AREA (NORMAL POOL) = 0.04 SQ. IN. (PLANIMETERED)
= 3.7 ACRES.

SURFACE AREA AT CONTOUR 1300 = 0.063 SQ IN (PLANIMETERED)
= 5.79 ACRES. = 5.8

SURFACE AREA AT CONTOUR 1320 = 0.13 SQ. IN. (PLANIMETERED)
= 11.9 ACRES

RATE OF AREA CHANGE PER FOOT OF RISE :

$$\frac{\Delta A}{\Delta Y} = \frac{(11.9 \text{ ACRES}) - (3.7 \text{ ACRES})}{(1320 \text{ FEET}) - (1291.8 \text{ FEET})} = 0.29 \text{ ACRE/FT}$$

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR DAM N^o 1
BY DLB DATE 10-24-78 PROJ. NO. 78-617-214
CHKD. BY WJV DATE 11/28/78 SHEET NO. 3 OF 17



UNIT HYDROGRAPH PARAMETERS

LENGTH OF LONGEST WATERCOURSE (L) \approx 1.17 MILES

LCA \approx 0.56 MILES

[VALUES OF L AND LCA
ARE FROM U.S.G.S. 7.5
MINUTE QUAD BROWNFIELD, PA.]

NOTE: ALL VARIABLES ARE DEFINED IN REFERENCE 2 IN THE
SECTION ENTITLED "SNYDER SYNTHETIC UNIT HYDROGRAPH"

C_e = 1.6

C_p = 0.5

[SUPPLIED BY C of E;
ZONE 29, OHIO RIVER BASIN]

t_p = SNYDER'S STANDARD LAG = $1.6 (L \times LCA)^{0.3}$

t_p = $(1.6) [(1.17)(0.56)]^{0.3} = 1.41$ HRS

PMP CALCULATIONS

HUTCHINSON RESERVOIR DAM N^o 1 LOCATION - ZONE 7 (REF 3)

PMP INDEX = 24 INCHES

(FIG 1, REF 3)

DURATION % INDEX -

6 HRS = 102

12 HRS = 120

24 HRS = 130

NOTE: A 24-HOUR RATHER THAN A 48-HR TOTAL
DURATION WAS USED. THIS WAS NECESSITATED
BY THE NEED TO USE A 5-MINUTE TIME
STEP IN THE HEC-I-DAM PROGRAM IN ORDER
TO MORE ACCURATELY DEFINE THE PEAKS
OF THE HYDROGRAPHS. (A MAXIMUM OF ONLY 300
TIME INTERVALS IS ALLOWED IN THE PROGRAM.)

SUBJECT DAM SAFETY INSPECTION.
HUTCHINSON RESERVOIR # 1
C. KHK DATE 10-12-78 PROJ. NO. 78-617-214
CHKD. BY RFV DATE 10-13-78 SHEET NO. 4 OF 17



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APPROXIMATE ELEVATION @ ZERO STORAGE

$$\text{VOLUME} = \frac{1}{3} HA \quad (\text{CONIC METHOD})$$

$$\text{VOLUME} = 45.4 \text{ ACRE-FT} \quad (\text{SEE NOTE SHEET 1})$$

$$\text{SURFACE AREA} = 3.7 \text{ ACRES} \quad (\text{PLANIMETERED})$$

$$H = \frac{3 \times 45.4}{3.7} = 36.8 \text{ FT.}$$

$$\text{ELEVATION AT SPILLWAY CREST} = 1291.8 \text{ FT} \quad (\text{WPW. FILE UNION TOWN OFFICE})$$

$$\begin{aligned} \text{ELEVATION AT ZERO VOLUME} &= 1291.8 - 36.8 \\ &= 1255 \text{ FT.} \end{aligned}$$

SUBJECT DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR DAM N^o 1

BY DLB DATE 1/5/79 PROJ. NO. 78-617-214

CHKD. BY WJV DATE 1/9/79 SHEET NO. 5 OF 17



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ACTUAL ESTIMATED ELEVATION - STORAGE RELATIONSHIP

ESTIMATED SURFACE AREA: $A = A_0 + \left(\frac{\Delta A}{\Delta Y}\right)Y$
(LINEAR INTERPOLATION EQUATION)

$A_0 = 3.7$ ACRES
 $\frac{\Delta A}{\Delta Y} = 0.29$ ACRE/FT
 $Y = (\text{ELEVATION OF CONCERN}) - 1291.8'$

ESTIMATED INCREMENTAL INCREASE IN STORAGE:

MODIFIED PRISMOIDAL FORMULA: $\Delta V_{1-2} = \frac{Y}{3} (A_1 + A_2 + \sqrt{A_1 \times A_2})$
(REF 14, pg 15)

| ELEVATION (FT) | ESTIMATED AREA (ACRE) | CUMULATIVE INCREASE IN STORAGE ABOVE NORMAL POOL VIA MOD. PRIS. EQ. (ACRE- FEET) | AVAILABLE STORAGE BELOW NORMAL POOL (ACRE- FEET) | ACTUAL ESTIMATED STORAGE (ACRE- FEET) |
|-------------------|-----------------------------|--|--|---|
| 1291.8 | 3.7 | 0 | 45 | 45* |
| 1292.0 | 3.8 | 1 | " | 46 |
| 1293.0 | 4.0 | 5 | " | 50 |
| 1294.0 | 4.3 | 9 | " | 54 |
| 1294.3 | 4.4 | 11 | " | 56 |
| 1295.0 | 4.6 | 14 | " | 59 |
| 1296.0 | 4.9 | 19 | " | 64 |
| 1297.0 | 5.2 | 24 | " | 69 |
| 1298.0 | 5.5 | 29 | " | 74 |
| 1299.0 | 5.8 | 35 | " | 80 |
| 1300.0 | 6.1 | 40 | " | 85 |

* KNOWN VALUE (SEE NOTE SHEET 1)

EL 1291.8 - NORMAL POOL

EL 1294.3 - Top of DAM

SUBJECT DAM SAFETY INSPECTION.

HUTCHINSON RESERVOIR # 1

BY DLD

DATE 1-13-79

PROJ. NO. 78-617-214

CHKD. BY WJV

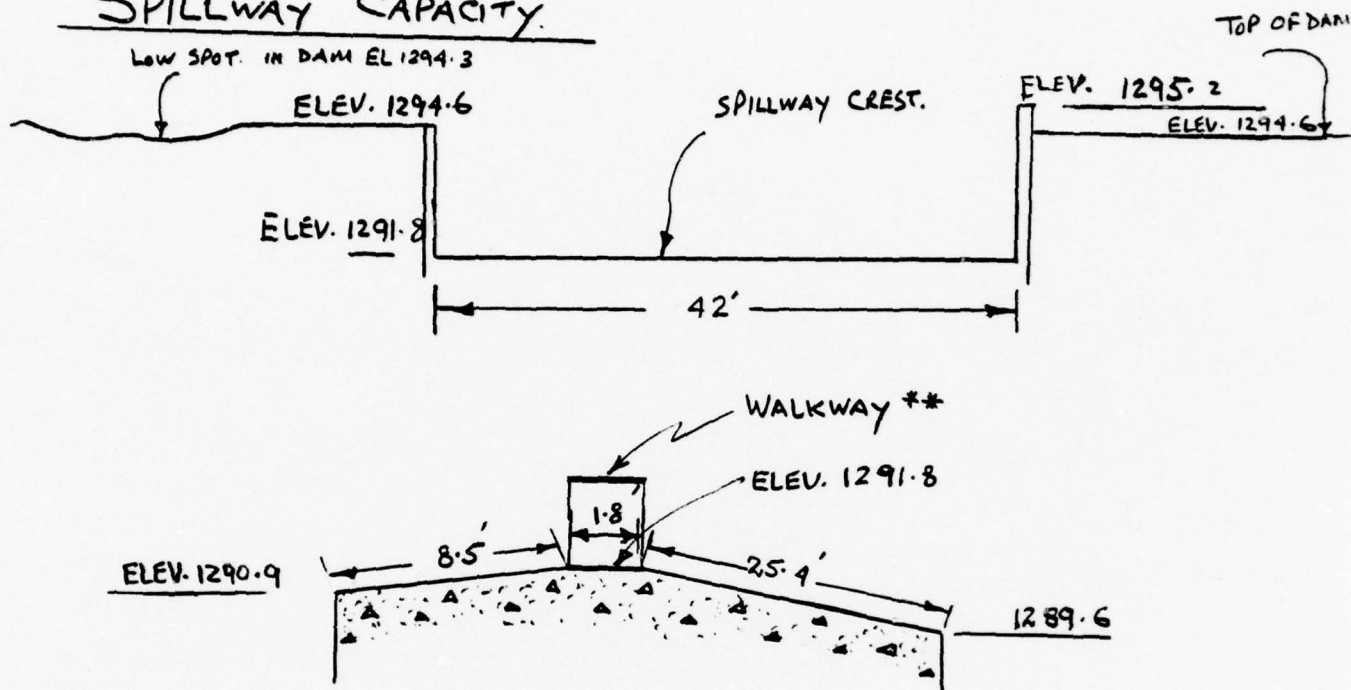
DATE 1-13-79

SHEET NO. 6 OF 17

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SPILLWAY CAPACITY.



$$\text{MAXIMUM HEAD} = 1294.3 - 1291.8 = 2.5 \text{ FT.}$$

$$\text{LENGTH OF WEIR} = 42 \text{ FT.}$$

$$Q = C L H^{3/2}$$

(REF 5, EP 5-10)

$$= 3.07^* \times 42 \times (2.5)^{3/2}$$

* C VALUE EXTRAPOLATED
FROM TABLE 5-3 REFS

$$= 509.7 \text{ CFS (say 510 CFS)}$$

** WALKWAY ALLOWANCE NEGLECTED

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR # 1
 BY DLB DATE 1/13/79 PROJ. NO. 78-617-214
 CHKD. BY WJV DATE 1/13/79 SHEET NO. 7 OF 17



SPILLWAY RATING CURVE

$$Q = C^* L H^{3/2}$$

* C VALUE EXTRAPOLATED ** TOP OF DAM

| ELEVATION FT. | H FT | $H^{3/2}$ | C^* | Q CFS |
|------------------|---------|-----------|-------|----------|
| 1291.8 | 0 | 0 | 0 | 0 |
| 1292 | 0.2 | .089 | 2.54 | 10 |
| 1292.5 | 0.7 | .586 | 2.61 | 64 |
| 1293 | 1.2 | 1.31 | 2.7 | 149 |
| 1293.5 | 1.7 | 2.22 | 2.88 | 269 |
| 1294 | 2.2 | 3.26 | 2.94 | 403 |
| 1294.3** | 2.5 | 3.95 | 3.07 | 510 |
| 1295 | 3.2 | 5.72 | 3.25 | 781 |
| 1295.5 | 3.7 | 7.12 | 3.32 | 992 |
| 1296 | 4.2 | 8.61 | 3.32 | 1200 |
| 1297 | 5.2 | 11.86 | 3.32 | 1653 |
| 1298 | 6.2 | 15.44 | 3.32 | 2153 |
| 1299 | 7.2 | 19.32 | 3.32 | 2694 |

SUBJECT DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR DAM No 1

BY DLB DATE 10-20-78 PROJ. NO. 78-617-214

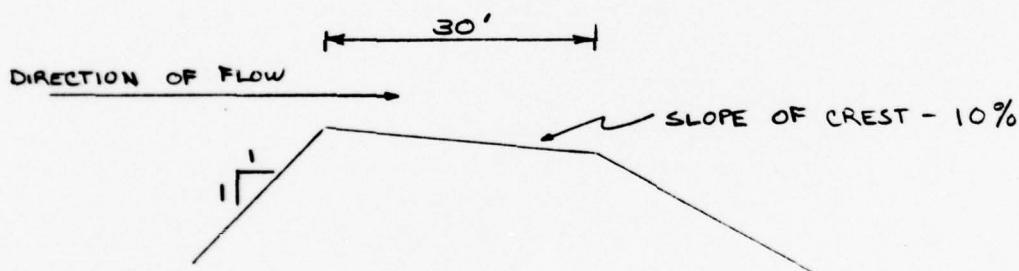
CHKD. BY WJV DATE 11/20/78 SHEET NO. 8 OF 17



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MAIN DAM

THE TOP OF DAM IS AT ELEVATION 1294.3. THIS IS THE POINT WHERE OVERTOPPING OF THE DAM STARTS. THE TOTAL COMBINED LENGTH OF THE DAM, EXCLUDING THE SPILLWAY, IS 278 FT. THE BREADTH OF THE CREST OF THE DAM IS 30 FT AND IS ON A 10% SLOPE AS SHOWN BELOW.



$$Q = CLH^{3/2}$$

(REF 5, EQ 5-10)

BREATH OF CREST = 30 FT

LENGTH OF DAM = 278 FT

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR DAM No 1
 BY REV DATE 10-23-78 PROJ. NO. 78-617-214
 CHKD. BY KML DATE 10-24-78 SHEET NO. 9 OF 17



MAIN DAM RATING CURVE

$$Q = C * L * H^{3/2}$$

| ELEVATION | H (FT) | H ^{3/2} | H/B | C | Q (CFS) |
|-----------|-----------|------------------|-------|------|------------|
| 1294.3 | 0 | 0 | 0 | | 0 |
| 1295 | 0.7 | 0.586 | 0.023 | 3.03 | 493 |
| 1295.5 | 1.2 | 1.315 | 0.04 | 3.04 | 1111 |
| 1296 | 1.7 | 2.217 | 0.057 | 3.04 | 1873 |
| 1297 | 2.7 | 4.437 | 0.090 | 3.05 | 3762 |
| 1298 | 3.7 | 7.117 | 0.123 | 3.05 | 6035 |
| 1299 | 4.7 | 10.189 | 0.157 | 3.06 | 8668 |

* VALUES OF "C" ARE TAKEN FROM REFERENCE 12, FIG. 24, pg 46

THE EFFECT OF THE 10% CREST SLOPE ON THE WEIR COEFFICIENTS IS NEGLIGIBLE IF THE CURVE OF REFERENCE 12 IS USED TO DETERMINE THE "C"'S (REF. 5 and 8).

SUBJECT DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR #1 DAM

EJM

DATE 10-30-78

PROJ. NO. 78-617-214

CHKD. BY DLB

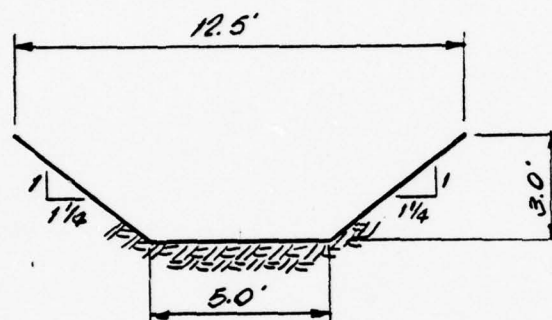
DATE 10-31-78

SHEET NO. 10 OF 17



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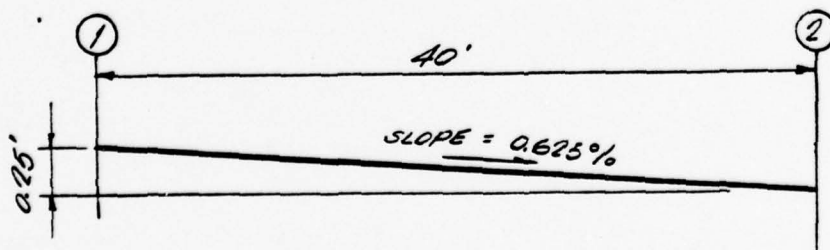
CALCULATION OF FLOW CAPACITY IN RACEWAY



NOTE: CHANNEL
IS LINED WITH
HIGH VEGETATION,
ROCK DEBRIS, AND
BRUSH. (FIELD
OBSERVATION)

TYPICAL CROSS-SECTION THROUGH RACEWAY *

SCALE: 1" = 5'



PROFILE THROUGH RACEWAY *

SCALE: 1" = 10' H

1" = 1' V

* ALL DIMENSIONS REPRESENT FIELD MEASUREMENTS.

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR #1 DAM
BY EJM DATE 10-30-78 PROJ. NO. 78-617-214
CHKD. BY DLB DATE 10-31-78 SHEET NO. 11 OF 17



THE FOLLOWING SIMPLIFYING ASSUMPTIONS APPLY IN
APPROXIMATING THE FLOW CAPACITY OF THE RACEWAY:

1. THE LINING AS DESCRIBED BY THE NOTE ON
SHEET 10 IS CONSISTENT OVER THE ENTIRE CHANNEL
LENGTH, THEREFORE THE ROUGHNESS COEFFICIENT
IS UNIFORM.
2. THE SIDE SLOPES OF THE RACEWAY ARE CONSTANT
OVER THE CHANNEL LENGTH.
3. THE CHANNEL SLOPE IS CONSTANT AT 0.625%.
4. FLOW IS TURBULENT AND THE MANNING EQUATION
APPLIES.

MANNING EQUATION:

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2} \quad (\text{REF 7, EQ 5-6, PG 99})$$

WHERE: Q - QUANTITY OF FLOW (CFS)
n - ROUGHNESS COEFFICIENT
A - AREA OF FLOW (FT²)
R - HYDRAULIC RADIUS (FT) = $\frac{A}{WP}$
S - SLOPE (FT/FT)
WP - WETTED PERIMETER

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR DAM N^o 1
BY DLB DATE 10-30-78 PROJ. NO. 78-617-214
CHKD. BY WJV DATE 1/9/79 SHEET NO. 12 OF 17



- QUANTITY OF FLOW FOR $d = 3.0$

$$A = 2\left(\frac{1}{2}\right)(3.75')(3.0') + (5.0')(3.0') \\ = 26.25 \text{ FT}^2$$

$$WP = 4.8' + 5.0' + 4.8' \\ = 14.6 \text{ FT}$$

$$R = 26.25 \text{ FT}^2 / 14.6 \text{ FT} \\ = 1.80 \text{ FT}$$

$$S = 0.00625 \approx 0.006$$

$$n = 0.040$$

(REF 2, pg 112)

$$Q = \frac{1.49}{0.040} (26.25)(1.80)^{2/3} (0.006)^{1/2}$$

$$Q = 112.1 \text{ CFS}$$

- APPROXIMATE STORAGE CAPACITY @ FULL FLOW

RACEWAY LENGTH \approx 800 FT.

$$\text{STORAGE} = \text{AVERAGE SURFACE AREA} \times \text{AVERAGE DEPTH} \\ = [(12.5' \times 800') + (5.0' \times 800')] \times \frac{3'}{2} = 21000 \text{ FT}^3 = 0.48 \text{ A-F}$$

\therefore RACEWAY STORAGE IS INSIGNIFICANT AND WILL BE NEGLECTED

ASSUME RACEWAY FLOWS FULL BY THE TIME THE RESERVOIR WATER LEVEL RAISES 0.7 FT, DUE TO THE COMBINATION OF DIRECT DRAINAGE OF THE SUBAREA'S LONGEST WATERCOURSE AND THE CONTRIBUTIONS OF THE US RESERVOIR

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR N°1
 BY DLB DATE 1/13/79 PROJ. NO. 78-617-214
 CHKD. BY WJV DATE 1/13/79 SHEET NO. 13 OF 17



TOTAL DAM RATING CURVE (SPILLWAY + MAIN DAM + RACEWAY)

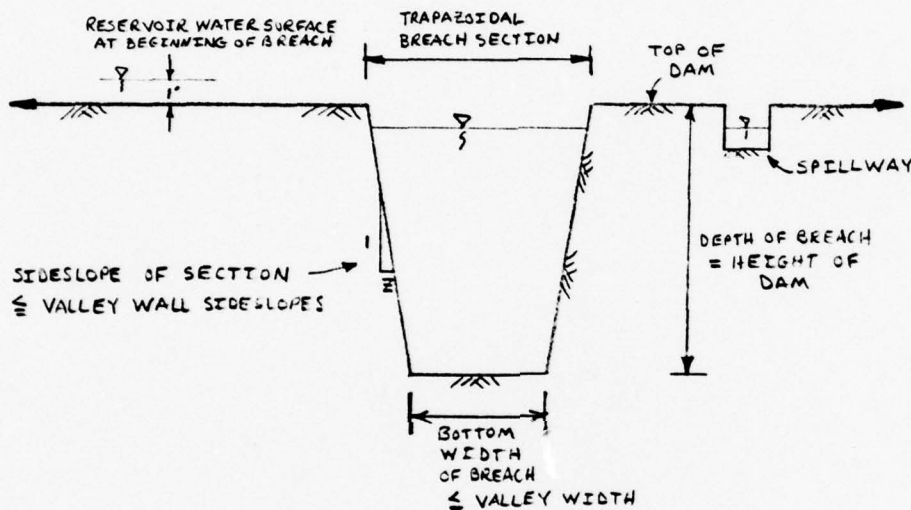
| ELEVATION | Q SPILLWAY | Q OVERTOPPING OF DAM | Q RACEWAY | Q (CFS) COMBINED |
|-----------|---------------|----------------------------|--------------|---------------------|
| 1291.8 | 0 | 0 | 0 | 0 |
| 1292. | 10 | 0 | 0 | 10 |
| 1292.5 | 64 | 0 | 112 | 176 |
| 1293 | 149 | 0 | 112 | 261 |
| 1293.5 | 268 | 0 | 112 | 380 |
| 1294 | 403 | 0 | 112 | 515 |
| 1294.3 | 510 | 0 | 112 | 622 |
| 1295 | 781 | 493 | 112 | 1386 |
| 1295.5 | 992 | 1111 | 112 | 2215 |
| 1296 | 1200 | 1873 | 112 | 3185 |
| 1297 | 1653 | 3762 | 112 | 5527 |
| 1298 | 2153 | 6035 | 112 | 8300 |
| 1299 | 2694 | 8668 | 112 | 11474 |

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR N°1
 BY WJV DATE 2-2-79 PROJ. NO. 73-617-214
 CHKD. BY DLB DATE 2-6-79 SHEET NO. 14 OF 17



BREACHING ASSUMPTIONS

TYPICAL BREACH SECTION:



HEC-1-DAM BREACHING ANALYSIS INPUTS:

(BREACHING IS INITIATED WHEN THE RESERVOIR WATER SURFACES REACH THE TOPS OF THE DAMS)

| PLAN NUMBER AND COMMENTS | RESERVOIR N°3 | | | | RESERVOIR N°2 | | | | RESERVOIR N°1 | | | |
|--|-----------------------------------|-------------------------|----------------------|-------------------------|-----------------------------------|-------------------------|----------------------|-------------------------|-----------------------------------|-------------------------|----------------------|------------------------|
| | BREACH BOTTOM WIDTH (FT) | BREACH DEPTH (FT) | SECTION SIDESLOPE | BREACH* TIME (HR) | BREACH BOTTOM WIDTH (FT) | BREACH DEPTH (FT) | SECTION SIDESLOPE | BREACH* TIME (HR) | BREACH BOTTOM WIDTH (FT) | BREACH DEPTH (FT) | SECTION SIDESLOPE | BREACH TIME (HR) |
| ① MINIMUM BREACH SECTIONS, INSTANTANEOUS FAIL TIMES | 0 | 56 | 0.5+1 | 0.25 | 0 | 47 | 0.5+1 | 0.25 | 0 | 33 | 0.5+1 | 0.25 |
| ② MAXIMUM BREACH SECTIONS, INSTANTANEOUS FAIL TIMES | 150 | 56 | 2+1 | 0.25 | 100 | 47 | 4+1 | 0.25 | 100 | 33 | 2.5+1 | 0.25 |
| ③ MINIMUM BREACH SECTIONS, PROLONGED FAIL TIMES | 0 | 56 | 0.5+1 | 4.0 | 0 | 47 | 0.5+1 | 4.0 | 0 | 33 | 0.5+1 | 4.0 |
| ④ MAXIMUM BREACH SECTIONS, PROLONGED FAIL TIMES | 150 | 56 | 2+1 | 4.0 | 100 | 47 | 4+1 | 4.0 | 100 | 33 | 2.5+1 | 4.0 |
| ⑤ AVERAGE POSSIBLE CONDITIONS | 100 | 56 | 1+1 | 2.0 | 50 | 47 | 1+1 | 2.0 | 50 | 33 | 1+1 | 1.0 |

* BREACH TIME = TOTAL TIME NECESSARY TO REACH THE FINAL BREACH DIMENSIONS

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR NO 2
 BY WJV DATE 1/9/79 PROJ. NO. 78-617-214
 CHKD. BY DLB DATE 1/9/79 SHEET NO. 15 OF 17



ASSUMPTIONS ARE BASED SOMEWHAT ON THE FOLLOWING
 SUGGESTED RANGES FOR EARTH DAM BREACHING*:

- BREACH BOTTOM WIDTH $\rightarrow \frac{\text{DAM HEIGHT}}{2} < \text{WIDTH} < 3 \times (\text{DAM HEIGHT})$
- SECTION SIDESLOPE $\rightarrow 0 < Z < 1$
- BREACH TIME $\rightarrow 0.5 < \text{TIME} < 4.0$
- WATER SURFACE HEIGHT ABOVE DAM AT WHICH BREACHING
 BEGINS $\rightarrow 1 < \text{HEIGHT} < 5$

AND ALSO ON THE PHYSICAL CONSTRAINTS OF THE DAM
 AND SURROUNDING TERRAIN:

| CONSTRAINT | RESERVOIR NO 3 | RESERVOIR NO 2 | RESERVOIR NO 1 |
|---------------------------------|--|--|---|
| - HEIGHT OF DAM | 56' | 47' | 33' |
| - LENGTH OF DAM CREST W/O SW | 400' | 510' (MAIN DAM ONLY) | 273' |
| ** - VALLEY BOTTOM WIDTH | 150' | 100' | 100' |
| ** - VALLEY SS: RIGHT WALL | 3 to 1 | 4 to 1 | 3.5 to 1 |
| LEFT WALL | 4.5 to 1 | 5 to 1 | 4 to 1 |
| DESCRIPTION | EARTH DAM WITH CONCRETE CORE WALL AND CONCRETE US FACE COVERING | EARTH DAM WITH CONCRETE CORE WALL AND HAND PLACED RIP RAP US AND DS FACE COVERINGS | EARTH DAM WITH CLAY CORE AND CONCRETE US FACE COVERING |

* INFORMATION OBTAINED FROM BALTIMORE DISTRICT, CORPS OF ENGINEERS
 ** ESTIMATED FROM USGS MAP

SUBJECT

DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR NO 1

BY WJV

DATE 2-2-79

PROJ. NO. 78-617-214

CHKD. BY DLB

DATE 2-6-79

SHEET NO. 16 OF 17

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HEC-1-DAM BREACHING ANALYSIS OUTPUT:

RESERVOIR DATA

| OUTPUT FOR RESERVOIR NO | PLAN NUMBER | VARIABLE BREACH BOTTOM WIDTH | | | ACTUAL MAX. FLOW DURING FAILURE TIME (CFS) | CORRESPONDING TIME OF FLOW (HR) | INTERPOLATED OR HEC-1 ROUTED MAX FLOW DURING FAIL TIME (CFS) | CORRESPONDING TIME OF FLOW (HR) | ACTUAL PEAK FLOW THROUGH DAM (CFS) | CORRESPONDING TIME OF PEAK (HR) | TIME OF INITIAL BREACH (HR) |
|-------------------------------|----------------|---------------------------------|--------|--------|--|---------------------------------------|--|---------------------------------------|---|---------------------------------------|-----------------------------------|
| | | RES. 1 | RES. 2 | RES. 3 | | | | | | | |
| 3 | ① | 0 | - | - | 19572 | 18.50 | 19572 | 18.50 | 19572 | 18.50 | 18.25 |
| | ② | 150 | - | - | 29691 | 18.37 | 26648 | 18.33 | 29691 | 18.37 | 18.25 |
| | ③ | 0 | - | - | 3138 | 20.42 | 3138 | 20.42 | 3138 | 20.42 | 18.25 |
| | ④ | 150 | - | - | 4330 | 18.75 | 4330 | 18.75 | 4330 | 18.75 | 18.25 |
| | ⑤ | 100 | - | - | 5997 | 18.63 | 5982 | 18.58 | 5997 | 18.63 | 18.25 |
| | ⑥ | 100 | - | - | 5996 | 18.63 | 5996 | 18.63 | 5996 | 18.63 | 18.50 |
| 2 | ① | 0 | 0 | 0 | 12319 | 18.42 | 12319 | 18.42 | 15532 | 18.58 | 18.17 |
| | ② | 150 | 100 | 100 | 32481 | 18.37 | 32303 | 18.42 | 32481 | 18.37 | 18.17 |
| | ③ | 0 | 0 | 0 | 3762 | 20.42 | 3762 | 20.42 | 3762 | 20.42 | 18.17 |
| | ④ | 150 | 100 | 100 | 5255 | 18.75 | 5255 | 18.75 | 5255 | 18.75 | 18.17 |
| | ⑤ | 100 | 50 | 50 | 7734 | 18.75 | 7734 | 18.75 | 7734 | 18.75 | 18.17 |
| | ⑥ | 100 | 50 | 50 | 7597 | 18.92 | 7597 | 18.92 | 7597 | 18.92 | 18.33 |
| 1 | ① | 0 | 0 | 0 | 2847 | 16.14 | 2771 | 16.50 | 15715 | 18.58 | 16.25 |
| | ② | 150 | 100 | 100 | 4636 | 16.31 | 3095 | 16.33 | 33969 | 18.42 | 16.25 |
| | ③ | 0 | 0 | 0 | - | - | - | - | 3427 | 20.50 | 16.25 |
| | ④ | 150 | 100 | 100 | 5748 | 18.75 | 5748 | 18.75 | 5748 | 18.75 | 16.25 |
| | ⑤ | 100 | 50 | 50 | 1738 | 16.48 | 1628 | 16.42 | 9115 | 18.75 | 16.25 |
| | ⑥ | 100 | 50 | 50 | 8479 | 18.90 | 8385 | 18.92 | 9479 | 18.90 | 18.42 |

** { AVERAGE POSSIBLE CONDITIONS -

* See Table on Sheet 14.

* See Table on Sheet 14.

DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR N^o 1

BY WJV

DATE 2-2-79

PROJ. NO. 79-617-214

CHKD. BY DLB

DATE 2-6-79

SHEET NO. 17 OF 17



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HEC-1-DAM BREACHING ANALYSIS OUTPUT:

DOWNSTREAM ROUTING DATA

| 1. PLAN No. | VARIABLE BREACH | | | OUTPUT @ X-SECT LOCATED 250 FT DS OF DAM No.1 | | | | | OUTPUT @ X-SECT LOCATED 1500 FT DS OF DAM No.1 | | | | |
|-------------------|-----------------|-------|-------|---|-------------------------|----------------------|----------------------------|----------------|--|-------------------------|----------------------|----------------------------|----------------|
| | BOTTOM WIDTH | | | PEAK FLOW (CFS) | TIME OF FLOW (HR) | CORR WSEL (FT) | WSEL w/o BREACH (FT) | Δ ELEV (FT) | PEAK FLOW (CFS) | TIME OF FLOW (HR) | CORR WSEL (FT) | WSEL w/o BREACH (FT) | Δ ELEV (FT) |
| | RES.3 | RES.2 | RES.1 | | | | | | | | | | |
| ① | 0 | 0 | 0 | 15883 | 18.58 | 1266.0 | 1250.6 | 9.4 | 16206 | 19.58 | 1220.9 | 1211.7 | 9.2 |
| ② | 150 | 100 | 100 | 34669 | 18.42 | 1271.6 | 1256.6 | 15.0 | 34624 | 18.42 | 1225.6 | 1211.7 | 13.9 |
| ③ | 0 | 0 | 0 | 3936 | 20.50 | 1259.4 | 1256.6 | 2.8 | 3930 | 20.50 | 1214.7 | 1211.7 | 3.0 |
| ④ | 150 | 100 | 100 | 5750 | 18.93 | 1260.5 | 1256.6 | 4.2 | 5762 | 19.93 | 1216.0 | 1211.7 | 4.3 |
| ⑤ | 100 | 50 | 50 | 8112 | 18.75 | 1262.3 | 1256.6 | 5.7 | 8040 | 18.75 | 1217.5 | 1211.7 | 5.8 |
| ⑥ | 100 | 50 | 50 | 8415 | 18.92 | 1262.5 | 1256.6 | 5.9 | 8325 | 18.92 | 1217.7 | 1211.7 | 6.0 |

1. SEE TABLE ON SHEET 14
2. BASE FLOW ELEVATIONS CORRESPONDING TO THE PEAK $\frac{1}{2}$ PMF FLOW. ESTIMATED FROM THE OVERTCIPPING ANALYSIS OUTPUT (SEE SUMMARY INPUT/OUTPUT SHEETS)
3. Δ ELEV = (CORRESPONDING WSEL) - (WSEL W/O BREACH)
4. BASED ON ASSUMPTION OF $\frac{1}{2}$ FT OF OVERTCIPPING PRIOR TO BREACHING (AVERAGE POSSIBLE CONDITIONS)

DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR NO 1

BY WJV

DATE 2-6-79

PROJ. NO. 79-617-214

CHKD. BY

DATE _____

SHEET NO. A OF



**Engineers • Geologists • Planner
Environmental Specialists**

SUMMARY INPUT/OUTPUT

HUTCHINSON DAMS
1, # 2, AND # 3

OVERTOPPING ANALYSIS

(w/ ARTIFICIALLY
INCREASED STORAGE
FOR RESERVOIR #2)

DAM SAFETY INSPECTION PENNSYLVANIA 214 AND 215
BOUCHINSON RESERVOIRS #1 AND #2 (W/ US ANALYSIS OF RESERVOIR #2)

NOTES AND SPECIFICATION

| | | | | | | |
|-----|-----|------|-------|-----|-------|-------|
| du | MNR | NMIN | IDAY | IHR | IATN | METNC |
| zer | 6 | 5 | 9 | 0 | 0 | 0 |
| | | | JOPER | N=I | LKOPT | TRACC |
| | | | 5 | 0 | 0 | 0 |

ULTI-PLA, ANALISED TO BE PERFORMED

```

RTIUS=      .20      .30      .40      1.00
NPLAN= 1 NRTIUS= 4 LRTIUS= 1

```

[illegible]

SUB-AREA MUNOFF COMPUTATION

INFLON IN RESERVUIN = 3

| INSTAG | ICOMP | IECUM | IIAPE | JP'T | JPRI | INAME | ISTAGE | IAU10 |
|--------|-------|-------|-------|------|------|-------|--------|-------|
| 3 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |

| HYDROGRAPH DATA | | | | | |
|-----------------|------|------|------|--------|-------|
| TIME | INCH | TARE | SNAP | TRSDA | TRSPC |
| 1 | 1 | 1.90 | 0.00 | 1.90 | 0.00 |
| 2 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 3 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 4 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 5 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 6 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 7 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 8 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 9 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 10 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 11 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 12 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 13 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 14 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 15 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 16 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 17 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 18 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 19 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 20 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 21 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 22 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 23 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 24 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 25 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 26 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 27 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 28 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 29 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 30 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 31 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 32 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 33 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 34 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 35 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 36 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 37 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 38 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 39 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 40 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 41 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 42 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 43 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 44 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 45 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 46 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 47 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 48 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 49 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 50 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 51 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 52 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 53 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 54 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 55 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 56 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 57 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 58 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 59 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 60 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 61 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 62 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 63 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 64 | 1 | 1.90 | 0.00 | 0.00 | 0.00 |
| 65 | 1 | 1.90 | 0.00 | 0.00</ | |

INSPC COMPUTED BY THE PROGRAM IS
SPEC: 0.00

| | PMS | K6 | PRECIP DATA | | | K96 |
|------|-------|--------|-------------|--------|------|-----|
| | | | K12 | R24 | K72 | |
| SPFF | | | | | | |
| 0.00 | 24.00 | 102.00 | 120.00 | 130.00 | 0.00 | |
| | | | | | 0.00 | |

| LUSS DATA | | | | | | | | | | |
|-----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| LRKOPF | STAKK | ULTRK | FTIOL | EPAL4 | STAKS | MIJOK | STMTL | CNSLL | ALSAK | MTIMP |
| 0 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 1.00 | 1.00 | .05 | 0.00 | 0.00 |

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UNIT HYDROGRAPH DATA
TP= 2.43 CP= .50 NTA= 0
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| | | |
|---|----------|--------------|
| APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SMDER CP AND IF | TC=30.29 | MILOE= 2.00 |
| INTERVALS | | |
| NECESSARY DATA | | |
| SINQ= | -1.50 | SINCSN= -.05 |

| 2. | 6. | 12. | 25. | 39. | 49. | 61. | 72. |
|------|------|------|------|------|------|------|------|
| 97. | 110. | 124. | 136. | 152. | 166. | 192. | 215. |
| 233. | 241. | 247. | 254. | 257. | 261. | 263. | 262. |
| 251. | 245. | 239. | 233. | 221. | 216. | 210. | 205. |
| 193. | 190. | 183. | 180. | 176. | 171. | 167. | 159. |
| 151. | 147. | 143. | 140. | 136. | 133. | 130. | 123. |
| 117. | 114. | 111. | 108. | 106. | 103. | 100. | 95. |
| 91. | 88. | 86. | 83. | 82. | 80. | 78. | 74. |
| 70. | 69. | 67. | 65. | 64. | 62. | 60. | 57. |
| 55. | 53. | 52. | 51. | 49. | 48. | 47. | 43. |

SUBJECT

DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR NO 1

BY WJV

DATE 2-6-79

PROJ. NO. 78-617-214

CHKD. BY

DATE

SHEET NO. B OF

Engineers • Geologists • Planners
Environmental Specialists

NO. DA HR. MM PERIOD MAIN LOSS COMP U
END-OF-PERIOD FLOW
MULDA HR. MM PERIOD MAIN LOSS COMP U

SUM 24.96 23.08 1.88 264274.
(634.) (586.) (48.) (6191.33)

PMF

0.3 PMF

0.4 PMF

HYDROGRAPH ROUTING

ROUTE THRU RESERVOIR = 3

RESERVOIR
NO 3
INFLOW
HYDROGRAPHS

| PEAK | 0-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|-------|--------|---------|---------|--------------|
| 3677. | 2814. | 1004. | 1004. | 289074. |
| 104. | 80. | 28. | 28. | 8188. |
| | 13.78 | 15.65 | 15.65 | 19.65 |
| | 349.93 | 499.20 | 499.20 | 499.20 |
| | 1395. | 1991. | 1991. | 1991. |
| | 1721. | 2455. | 2455. | 2455. |
| PEAK | 0-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
| 1103. | 844. | 301. | 301. | 86707. |
| 31. | 24. | 9. | 9. | 2455. |
| | 4.13 | 5.90 | 5.90 | 5.90 |
| | 104.98 | 149.76 | 149.76 | 149.76 |
| | 419. | 597. | 597. | 597. |
| | 516. | 737. | 737. | 737. |
| PEAK | 0-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
| 1471. | 1126. | 401. | 401. | 115010. |
| 42. | 32. | 11. | 11. | 3274. |
| | 5.51 | 7.86 | 7.86 | 7.86 |
| | 139.97 | 199.68 | 199.68 | 199.68 |
| | 556. | 796. | 796. | 796. |
| | 888. | 982. | 982. | 982. |

HYDROGRAPH ROUTING

ROUTE THRU RESERVOIR = 3

| | | | | | | | | |
|------------|---------|---------|--------------|---------|---------|---------|---------|----------|
| IS180 | ICUMP | IFCUN | ITAPE | JPLT | JPWT | INAKE | ISTAGE | IAUTU |
| 303 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| | | | ROLLING DATA | | | | | |
| ULOSS | AVG | IKES | ISAKE | IOPT | IPMP | | IS1K | |
| 0.0 | 0.00 | 1 | 1 | 0 | 0 | | 0 | |
| | | | | | | | | |
| MSIES | MSIDL | IAG | ANSKK | X | ISK | SIUKA | ISPRAT | |
| 1 | 0 | 0 | 0.000 | 0.000 | 0.000 | 0. | -1 | |
| | | | | | | | | |
| STAGE | 1375.50 | 1380.50 | 1385.50 | 1390.50 | 1395.50 | 1400.50 | 1405.50 | 1410.50 |
| | 1430.50 | 1431.50 | 1432.50 | 1433.50 | 1434.50 | 1435.50 | 1436.50 | 1437.50 |
| | | | | | | | | |
| FL04 | 0.00 | 126.00 | 126.00 | 126.00 | 126.00 | 126.00 | 126.00 | 126.00 |
| | 146.00 | 279.00 | 622.00 | 883.00 | 1382.00 | 3630.00 | 6771.00 | 10511.00 |
| | | | | | | | | |
| CAPACITY= | 0. | 340. | 11. | 25. | 45. | 100. | 137. | 440. |
| | | | 355. | 394. | 399. | 420. | 441. | 464. |
| | | | | | | | | |
| ELEVATION= | 1375. | 1381. | 1386. | 1391. | 1396. | 1401. | 1406. | 1411. |
| | 1431. | 1432. | 1433. | 1433. | 1434. | 1435. | 1436. | 1437. |
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SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR No 1
 BY WJV DATE 2-6-79 PROJ. NO. 79-617-214
 CHKD. BY _____ DATE _____ SHEET NO. C OF _____

gai
 CONSULTANTS.
 Engineers • Geologists • Planners
 Environmental Specialists

RESERVOIR

NO 3

OUTFLOW

HYDROGRAPHS

OVERTOPPING

OCCURS

@

APPROXIMATELY

0.37 PMF

PMF

0.3 PMF

0.4 PMF

PEAK OUTFLOW IS 3671. AT TIME 18.00 HOURS

| 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|------------------|---------|---------|--------------|
| PEAK 3671. | 808. | 808. | 237634. |
| CFS 104. | 21. | 23. | 5587. |
| INCHES 78. | 15.82 | 15.82 | 15.82 |
| MA 341.40 | 401.80 | 401.80 | 401.80 |
| AC-FT 1361. | 1602. | 1602. | 1602. |
| THOUS CU M 1679. | 1976. | 1976. | 1976. |

PEAK OUTFLOW IS 511. AT TIME 21.50 HOURS

| 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|-----------------|---------|---------|--------------|
| PEAK 511. | 121. | 121. | 34745. |
| CFS 14. | 3. | 3. | 984. |
| INCHES 1.47 | 2.36 | 2.36 | 2.36 |
| MA 37.39 | 60.01 | 60.01 | 60.01 |
| AC-FT 149. | 239. | 239. | 239. |
| THOUS CU M 184. | 295. | 295. | 295. |

PEAK OUTFLOW IS 1194. AT TIME 17.00 HOURS

| 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|-----------------|---------|---------|--------------|
| PEAK 1194. | 218. | 218. | 62899. |
| CFS 34. | 6. | 6. | 1761. |
| INCHES 3.24 | 4.28 | 4.28 | 4.28 |
| MA 84.73 | 104.64 | 104.64 | 104.64 |
| AC-FT 348. | 433. | 433. | 433. |
| THOUS CU M 417. | 534. | 534. | 534. |

SUB-AREA RUNOFF COMPUTATION

INFLOW TO RESERVOIR = 2

| ISLAW | ICOMP | IECUN | IIAPE | IPLI | IPMT | ISAME | ISAGE | IAITU |
|-------|-------|-------|-------|------|------|-------|-------|-------|
| 2 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |

INSPC COMPUTED BY THE PROGRAM IS .800

| INPDT | SIRW | ULIEM | MIUL | EMAIN | SIPAS | MTIUK | STHFL | CNSTL | ALSHA | MTIMP |
|-------|------|-------|------|-------|-------|-------|-------|-------|-------|-------|
| 0 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 1.00 | 1.00 | .05 | 0.00 | 0.00 |

UNIT HYDROGRAPH DATA
 IPZ .77 CPZ .50 PIAS 0

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNIPEL CP AND IP ARE TCZ 9.92 AND R=12.57 INTERVALS

SUBJECT

DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR No 1

Y WIV

DATE

2-6-79

PROJ. NO.

78-617-214

CHKD. BY

DATE

SHEET NO.

D

OF

Engineers • Geologists • Planner
Environmental Specialists

| UNIT HYDROGRAPH 72 END-UP-PERIOD UNOJINALS, LAKE .77 HOURS, CFS .50 VOLUME 1.00 | | | | | | | | | | | | |
|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1. | 5. | 9. | 13. | 17. | 21. | 25. | 29. | 33. | 37. | 41. | 45. | 49. |
| 36. | 34. | 31. | 29. | 26. | 24. | 23. | 21. | 19. | 18. | | | |
| 10. | 15. | 14. | 13. | 11. | 10. | 9. | 9. | 8. | | | | |
| 7. | 7. | 6. | 6. | 5. | 5. | 4. | 4. | 4. | | | | |
| 3. | 3. | 3. | 3. | 2. | 2. | 2. | 2. | 2. | | | | |
| 2. | 1. | 1. | 1. | 1. | 1. | 1. | 1. | 1. | | | | |
| 1. | 1. | 1. | 1. | 0. | 0. | | | | | | | |
| 0. | 0. | | | | | | | | | | | |

| END-UP-PERIOD FLOW | | | | | SUM | | |
|--------------------|-------|--------|------|------|------|------|------|
| MO.UA | HH.MN | PERIOD | RAIN | EXCS | LOSS | EXCS | LOSS |
| U | | | | | | | |
| MO.UA | HH.MN | PERIOD | RAIN | EXCS | LOSS | EXCS | LOSS |
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SUBJECT

DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR NO 1

Y WJV

DATE

2-6-79

PROJ. NO.

78-617-214

CHKD. BY

DATE

SHEET NO.

F OF

Engineers • Geologists • Planners
Environmental Specialists

PMF

| 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|--------|---------|---------|--------------|
| 2285. | 759. | 759. | 21850. |
| 66. | 21. | 21. | 6184. |
| 10.68 | 14.19 | 14.19 | 14.19 |
| 211.24 | 360.42 | 360.42 | 360.42 |
| 1133. | 1505. | 1505. | 1505. |
| 1397. | 1657. | 1657. | 1657. |

0.2 PMF

| 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|--------|---------|---------|--------------|
| 181. | 79. | 79. | 22644. |
| 5. | 2. | 2. | 641. |
| 74 | 1.47 | 1.47 | 1.47 |
| 18.92 | 37.34 | 37.34 | 37.34 |
| 79. | 156. | 156. | 156. |
| 97. | 192. | 192. | 192. |

0.3 PMF

| 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|--------|---------|---------|--------------|
| 497. | 131. | 131. | 37627. |
| 16. | 4. | 4. | 1065. |
| 1.44 | 2.44 | 2.44 | 2.44 |
| 36.45 | 62.05 | 62.05 | 62.05 |
| 152. | 259. | 259. | 259. |
| 188. | 320. | 320. | 320. |

PEAK OUTFLOW IS 2400. AT TIME 20.58 HOURS

| PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|--------|--------|---------|---------|--------------|
| 2400. | 2285. | 759. | 759. | 21850. |
| 66. | 66. | 21. | 21. | 6184. |
| 10.68 | 10.68 | 14.19 | 14.19 | 14.19 |
| 211.24 | 211.24 | 360.42 | 360.42 | 360.42 |
| 1133. | 1133. | 1505. | 1505. | 1505. |
| 1397. | 1397. | 1657. | 1657. | 1657. |

PEAK OUTFLOW IS 181. AT TIME 16.75 HOURS

| PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|-------|--------|---------|---------|--------------|
| 181. | 159. | 79. | 79. | 22644. |
| 5. | 5. | 2. | 2. | 641. |
| 74 | 74 | 1.47 | 1.47 | 1.47 |
| 18.92 | 18.92 | 37.34 | 37.34 | 37.34 |
| 79. | 79. | 156. | 156. | 156. |
| 97. | 97. | 192. | 192. | 192. |

PEAK OUTFLOW IS 497. AT TIME 21.92 HOURS

| PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|-------|--------|---------|---------|--------------|
| 497. | 307. | 131. | 131. | 37627. |
| 16. | 9. | 4. | 4. | 1065. |
| 1.44 | 1.44 | 2.44 | 2.44 | 2.44 |
| 36.45 | 36.45 | 62.05 | 62.05 | 62.05 |
| 152. | 152. | 259. | 259. | 259. |
| 188. | 188. | 320. | 320. | 320. |

SUB-AREA MUNDOFF COMPUTATION

INFLOW TO RESERVOIR #1

| ISIAO | ICOMP | IECON | ISAPE | JPL1 | JPLT | ISARE | ISTAGE | IAUTO |
|-------|-------|-------|-------|------|------|-------|--------|-------|
| 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |

HYDROGRAPH DATA

| ISYD | ISYD | ISYD | ISYD | ISYD | ISYD | ISYD | ISYD | ISYD |
|------|------|------|------|------|------|------|------|------|
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

PEAK DATA

| ISYD | ISYD | ISYD | ISYD | ISYD | ISYD | ISYD | ISYD | ISYD |
|------|------|------|------|------|------|------|------|------|
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

LOSS DATA

| ISYD | ISYD | ISYD | ISYD | ISYD | ISYD | ISYD | ISYD | ISYD |
|------|------|------|------|------|------|------|------|------|
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

UNIT HYDROGRAPH DATA

| ISYD | ISYD | ISYD | ISYD | ISYD | ISYD | ISYD | ISYD | ISYD |
|------|------|------|------|------|------|------|------|------|
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

UNIT HYDROGRAPH DATA

| ISYD | ISYD | ISYD | ISYD | ISYD | ISYD | ISYD | ISYD | ISYD |
|------|------|------|------|------|------|------|------|------|
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

UNIT HYDROGRAPH DATA

| ISYD | ISYD | ISYD | ISYD | ISYD | ISYD | ISYD | ISYD | ISYD |
|------|------|------|------|------|------|------|------|------|
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

UNIT HYDROGRAPH DATA

| ISYD | ISYD | ISYD | ISYD | ISYD | ISYD | ISYD | ISYD | ISYD |
|------|------|------|------|------|------|------|------|------|
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

RESERVOIR

No 2

OUTFLOW

HYDROGRAPHS

OVERTOPPING

OCCURS

@

0.27 PMF

SUBJECT

DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR No 1

WJV

DATE

2-6-79

PROJ. NO.

79-617-214

CHKD. BY

DATE

SHEET NO.

G

OF

Engineers • Geologists • Planner
Environmental Specialists

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN OUTFLOW CP AND IF ARE 10-17, 20 AND 22-30 INTERVALS

RECESSION DATA
STRIKE -1.50 UNCSH -0.50
MILLION 2.00
MILLION 10-17, 20 AND 22-30 INTERVALS

| UNIT HYDROGRAPHIC END-OF-PERIOD UNITS, LAGE | 1.40 HOURS, CFS | .50 VOLUME .98 |
|---|-----------------|----------------|
| 1. | 10. | 32. |
| 2. | 89. | 100. |
| 3. | 83. | 101. |
| 4. | 81. | 101. |
| 5. | 80. | 101. |
| 6. | 78. | 101. |
| 7. | 75. | 101. |
| 8. | 73. | 101. |
| 9. | 71. | 101. |
| 10. | 69. | 101. |
| 11. | 67. | 101. |
| 12. | 65. | 101. |
| 13. | 63. | 101. |
| 14. | 61. | 101. |
| 15. | 59. | 101. |
| 16. | 57. | 101. |
| 17. | 55. | 101. |
| 18. | 53. | 101. |
| 19. | 51. | 101. |
| 20. | 49. | 101. |
| 21. | 47. | 101. |
| 22. | 45. | 101. |
| 23. | 43. | 101. |
| 24. | 41. | 101. |
| 25. | 39. | 101. |
| 26. | 37. | 101. |
| 27. | 35. | 101. |
| 28. | 33. | 101. |
| 29. | 31. | 101. |
| 30. | 29. | 101. |
| 31. | 27. | 101. |
| 32. | 25. | 101. |
| 33. | 23. | 101. |
| 34. | 21. | 101. |
| 35. | 19. | 101. |
| 36. | 17. | 101. |
| 37. | 15. | 101. |
| 38. | 13. | 101. |
| 39. | 11. | 101. |
| 40. | 9. | 101. |
| 41. | 7. | 101. |
| 42. | 5. | 101. |
| 43. | 3. | 101. |
| 44. | 1. | 101. |

END-OF-PERIOD FLOW
MU, DA MR, MR PERIOD MAIN EACS LOSS CUMP Q

| MU, DA | MR, MR | PERIOD | MAIN | EACS | LOSS | CUMP Q |
|--------|----------|----------|---------|-------------|------|--------|
| SUR | 24.90 | 23.08 | 1.88 | 73844. | | |
| | (634.) | (586.) | (48.) | (2091.03) | | |

PMF

| PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|-------|--------|---------|---------|--------------|
| 1119. | 745. | 256. | 256. | 73819. |
| 34. | 21. | 7. | 7. | 2090. |
| | 16.11 | 22.18 | 22.18 | 22.18 |
| | 409.28 | 563.36 | 563.36 | 563.36 |
| | 369. | 504. | 504. | 504. |
| | 456. | 627. | 627. | 627. |

RESERVOIR
No 1
LOCAL
HYDROGRAPHS

0.2 PMF

| PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|------|--------|---------|---------|--------------|
| 424. | 149. | 51. | 51. | 24764. |
| 6. | 4. | 1. | 1. | 418. |
| | 3.22 | 4.44 | 4.44 | 4.44 |
| | 81.86 | 112.67 | 112.67 | 112.67 |
| | 74. | 102. | 102. | 102. |
| | 91. | 125. | 125. | 125. |

0.3 PMF

| PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|------|--------|---------|---------|--------------|
| 336. | 221. | 77. | 77. | 22140. |
| 10. | 6. | 2. | 2. | 627. |
| | 4.83 | 6.65 | 6.65 | 6.65 |
| | 122.78 | 169.01 | 169.01 | 169.01 |
| | 111. | 153. | 153. | 153. |
| | 137. | 188. | 188. | 188. |

COMBINE HYDROGRAPHS

COMBINE ADJUSTED PES. = 2 OUTFLOW = 7 AREA = 1 HUNDRED FOR INFLOW TO RESERVOIR #1

| ISIAW | ICOMP | RECON | ISIAPE | JPLT | JPLT | INAME | ISTAGE | IAUTU |
|-------|-------|-------|--------|------|------|-------|--------|-------|
| 1 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |

SUBJECT

DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR No 1

WIV

DATE

2-6-79

PROJ. NO.

79-617-214

CHKD. BY

DATE

SHEET NO.

H

OF


 Engineers • Geologists • Planner
 Environmental Specialists

| RESERVOIR | | | | PM F | | | |
|-------------|--------|--------|---------|---------|--------------|------------|-------|
| No 1 | | | | 0.2 PMF | | | |
| INFLOW | | | | 0.3 PMF | | | |
| HYDROGRAPHS | | | | | | | |
| THOUS CU M | PEAK | 0-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME | THOUS CU M | PEAK |
| CFS | 2811. | 2811. | 1015. | 1015. | 292379. | CFS | 404. |
| CMS | 87. | 80. | 29. | 29. | 8279. | CMS | 11. |
| INCHES | 10.61 | 10.61 | 15.61 | 15.61 | 15.61 | INCHES | 1.16 |
| AC-FT | 274.47 | 274.47 | 396.48 | 396.48 | 396.48 | AC-FT | 30.09 |
| | 1394. | 1394. | 2014. | 2014. | 2014. | | 153. |
| | 1719. | 1719. | 2484. | 2484. | 2484. | | 188. |
| | 308. | 308. | 130. | 130. | 37407. | | 4. |
| | 9. | 9. | 4. | 4. | 1059. | | 2.00 |
| | 1.16 | 1.16 | 2.00 | 2.00 | 2.00 | | 50.73 |
| | 30.09 | 30.09 | 50.73 | 50.73 | 50.73 | | 258. |
| | 153. | 153. | 258. | 258. | 258. | | 318. |
| | 188. | 188. | 318. | 318. | 318. | | 271. |
| THOUS CU M | PEAK | 0-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME | THOUS CU M | PEAK |
| CFS | 525. | 443. | 208. | 208. | 59773. | CFS | 525. |
| CMS | 16. | 13. | 6. | 6. | 1693. | CMS | 16. |
| INCHES | 1.70 | 1.70 | 3.19 | 3.19 | 3.19 | INCHES | 1.70 |
| AC-FT | 43.26 | 43.26 | 81.06 | 81.06 | 81.06 | AC-FT | 43.26 |
| | 220. | 220. | 412. | 412. | 412. | | 220. |
| | 271. | 271. | 508. | 508. | 508. | | 271. |

HYDROGRAPH ROUTING

HOUSE THRU RESERVOIR #1

| ISLAW | ICUMP | IRECON | ITAPE | JPL1 | JPMT | ISAME | ISTAGE | IAUTU |
|--------------|---------|---------|----------|---------|---------|---------|---------|---------|
| 101 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| ROUTING DATA | | | | | | | | |
| GLOSS | CLGSS | AVG | IMES | ISAME | IUPT | IPRP | LSIR | |
| 0.0 | 0.000 | 0.00 | 1 | 1 | 0 | 0 | 0 | |
| MSIPS | MSIDL | LAG | AMSAK | X | ISA | STOMA | ISPRAT | |
| 1 | 0 | 0 | 0.000 | 0.000 | 0.000 | 45. | -1 | |
| STAGE | 1291.60 | 1292.00 | 1292.50 | 1293.00 | 1293.50 | 1294.00 | 1294.50 | 1295.00 |
| | 1297.00 | 1298.00 | 1299.00 | | | | | 1295.50 |
| FLUX | 0.00 | 10.00 | 176.00 | 261.00 | 380.00 | 515.00 | 622.00 | 1386.00 |
| | 5277.00 | 8300.00 | 11476.00 | | | | | 2215.00 |
| CAPACITY | 0. | 45. | 46. | 50. | 54. | 56. | 59. | 64. |
| | 80. | | | | | | | 74. |
| ELEVATION | 1255. | 1292. | 1292. | 1293. | 1294. | 1294. | 1295. | 1296. |
| | 1295. | | | | | | | 1297. |
| DAM DATA | | | | | | | | |
| | CHNL | SP-10 | COOL | EXP | ELEV | COOL | CANLA | EXPI |
| | 1291.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
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SUBJECT

DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR N^o 1Y WIV

DATE

2-6-79

PROJ. NO.

79-617-214

CHKD. BY

DATE

SHEET NO.

I

OF

Engineers • Geologists • Planner
Environmental Specialists

| | | | | | | | | | | |
|---|---------|-----|--------|-------|------------|--------|---------|---------|--------------|--|
| RESERVOIR NR 1 OUTFLOW HYDROGRAPHS | PMF | | | | | | | | | |
| | PEAK | CFS | INCHES | AC-FT | THOUS CU M | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME | |
| | 3069. | 87. | | | | 2811. | 1007. | 1007. | 290111. | |
| | | | | | | 80. | 29. | 29. | 8215. | |
| OVERTOPPING OCCURS @ 0.33 PMF | 0.3 PMF | | | | | | | | | |
| | PEAK | CFS | INCHES | AC-FT | THOUS CU M | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME | |
| | 551. | 16. | | | | 443. | 204. | 204. | 58849. | |
| | | | | | | 13. | 6. | 6. | 1666. | |
| | 0.4 PMF | | | | | | | | | |
| | PEAK | CFS | INCHES | AC-FT | THOUS CU M | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME | |
| | 1242. | 35. | | | | 916. | 346. | 346. | 99504. | |
| | | | | | | 26. | 10. | 10. | 2818. | |

HYDROGRAPH ROUTING

DOWNSIDE CHANNEL ROUTING FROM RESERVOIR #1 TO SECTION 7

| | | | | | | | | |
|-------|-------|--------|-------|-------|-------|-------|--------|-------|
| ISTP | ICOMP | IRECON | IRATE | JPLT | JPRF | INAME | ISTAGE | IAUTO |
| 107 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| ULOSS | CLOSS | AVG | IRF | ISAME | IOPT | IPAP | LSTM | |
| 0.0 | 0.000 | 0.00 | 1 | 1 | 0 | 0 | 0 | |
| NSIPS | NSIOL | LAG | AMSCK | X | ISK | STUNA | ISPHAT | |
| 1 | 0 | 0 | 0.000 | 0.000 | 0.000 | 0. | 0. | |

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR No 1
 Y WJV DATE 2-6-79 PROJ. NO. 73-617-214
 CHKD. BY _____ DATE _____ SHEET NO. J OF _____

gai
 CONSULTANTS.
 Engineers • Geologists • Planner
 Environmental Specialists

NORMAL DEPTH CHANNEL ROUTING

QM(1) QM(2) QM(3) ELNVI ELMAX ELNTH SEL
 .1250 .0450 .1000 1252.0 1298.0 250. .05000

CRUSS SECTION COORDINATES--STA, ELEV, STA, ELEV--EIC
 0.00 1300.00 63.00 1280.00 180.00 1256.00 165.00 1252.00 180.00 1252.00
 183.00 1256.00 312.00 1280.00 415.00 1300.00

| STORAGE | 0.00 | .24 | .57 | 1.15 | 2.06 | 3.28 | 4.82 | 6.68 | 8.85 |
|----------|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|
| | 14.14 | 17.26 | 20.69 | 24.35 | 28.22 | 32.30 | 36.60 | 41.10 | 45.82 |
| UNITFLUE | 0.00 | 463.36 | 1667.88 | 3785.99 | 6951.84 | 11341.79 | 17116.20 | 24425.50 | 33412.00 |
| | 50962.53 | 71784.47 | 89195.85 | 109307.03 | 131613.63 | 156160.56 | 182995.99 | 212170.27 | 243735.16 |
| STAGE | 1252.00 | 1254.42 | 1256.84 | 1259.26 | 1261.68 | 1264.11 | 1266.53 | 1268.95 | 1271.37 |
| | 1276.21 | 1278.63 | 1281.05 | 1283.47 | 1285.89 | 1288.32 | 1290.74 | 1293.16 | 1295.58 |
| FLOW | 0.00 | 463.36 | 1667.88 | 3785.99 | 6951.84 | 11341.79 | 17116.20 | 24425.50 | 33412.00 |
| | 50962.53 | 71784.47 | 89195.85 | 109307.03 | 131613.63 | 156160.56 | 182995.99 | 212170.27 | 243735.16 |

| PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|-------|--------|---------|---------|--------------|
| 3066. | 2611. | 1007. | 1007. | 29661. |
| 87. | 80. | 29. | 29. | 8212. |
| | 10.81 | 15.48 | 15.48 | 15.48 |
| | 274.50 | 393.27 | 393.27 | 393.27 |
| | 1398. | 1997. | 1997. | 1997. |
| | 1720. | 4464. | 4464. | 2464. |

MAXIMUM STORAGE = 1.

MAXIMUM STAGE IS 1258.4

SUBJECT

DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR NO 1

Y WIV

DATE 2-6-79

PROJ. NO. 78-617-214

CHKD. BY

DATE

SHEET NO. K OF



Engineers • Geologists • Planners
Environmental Specialists

HYDROGRAPH ROUTING

DOWNSTREAM CHANNEL ROUTING FROM SECTION 7 TO SECTION 8

| ISIAQ | ICOMP | IECON | ISIAPE | JPLT | JPRF | INAME | ISAGE | IAUTO |
|--------------|-------|-------|--------|-------|-------|--------|-------|-------|
| 708 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| ROUTING DATA | | | | | | | | |
| OCLOS | AVG | IMES | ISAKE | IOPT | IPMP | | LSIK | |
| 0.0 | 0.00 | 1 | 1 | 0 | 0 | | 0 | |
| MSLPS | | | | | | | | |
| ASTUL | LAG | ARSKA | A | ISK | STOKA | ISPRAT | | |
| 1 | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0. | | |

NORMAL DEPTH CHANNEL ROUTING

| UM(1) | UM(2) | UM(3) | ELAVI | ELMAX | MINIM | SEL |
|-------|--------|--------|--------|--------|-------|--------|
| 0.00 | 0.0450 | 0.0800 | 1206.0 | 1260.0 | 1250. | .03300 |

CROSS SECTION COORDINATES -- STA, ELEV, STA, ELEV, ETC

0.00 1260.00 67.00 1240.00 340.00 1210.00 363.00 1206.00 378.00 1206.00

380.00 1212.00 590.00 1240.00 772.00 1260.00

| STORAGE | 0.00 | 1.35 | 3.32 | 6.11 | 16.69 | 29.68 | 46.46 | 67.25 | 92.04 |
|---------|----------|-----------|-----------|-----------|-----------|-----------|----------|-----------|-----------|
| | 153.64 | 190.64 | 231.24 | 275.44 | 342.53 | 372.51 | 425.37 | 461.12 | 519.75 |
| OUTFLOW | 0.00 | 475.58 | 1554.29 | 3715.40 | 7607.73 | 14022.98 | 23313.75 | 36022.02 | 54555.25 |
| | 99001.67 | 129620.01 | 165757.17 | 209683.11 | 259540.65 | 315503.46 | 37754.74 | 436463.41 | 521861.73 |
| STAGE | 1206.00 | 1208.94 | 1211.68 | 1214.53 | 1217.37 | 1220.21 | 1223.05 | 1225.89 | 1228.74 |
| | 1234.42 | 1237.26 | 1240.11 | 1242.95 | 1245.79 | 1248.63 | 1251.47 | 1254.32 | 1257.16 |
| FLW | 0.00 | 475.58 | 1554.29 | 3715.40 | 7607.73 | 14022.98 | 23313.75 | 36022.02 | 54555.25 |
| | 99001.67 | 129620.01 | 165757.17 | 209683.11 | 259540.65 | 315503.46 | 37754.74 | 436463.41 | 521861.73 |

| PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|------------|--------|---------|---------|--------------|
| 3067. | 2611. | 1005. | 1005. | 26952. |
| 67. | 60. | 28. | 28. | 8194. |
| INCHES | | | | |
| 10.81 | 15.45 | 15.45 | 15.45 | 15.45 |
| 274.47 | 392.36 | 392.36 | 392.36 | 392.36 |
| AC-PI | | | | |
| 1354. | 1993. | 1993. | 1993. | 1993. |
| THOUS CU M | | | | |
| 1719. | 2456. | 2456. | 2456. | 2456. |

PMF

MAXIMUM STORAGE = 7.

MAXIMUM STAGE IS 1213.7

SUBJECT

DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR No 1

Y WJV

DATE

2-6-79

PROJ. NO.

73-617-214

CHKD. BY

DATE

SHEET NO.

L OFEngineers • Geologists • Planners
Environmental Specialists

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1

ELEVATION
STORAGE
OUTFLOWINITIAL VALUE
1375.50
0.
0.SPILLWAY CHEST
1430.50
340.
126.TOP OF DAM
1433.10
390.
818.RESERVOIR
No 3RATIO
OF
PMFMAXIMUM
RESERVOIR
W.S.ELEVMAXIMUM
DEPTH
OVER DAMMAXIMUM
STORAGE
AC-FTMAXIMUM
OUTFLOW
CFSDURATION
OVER TOP
HOURSTIME OF
MAX OUTFLOW
HOURSTIME OF
FAILURE
HOURS0.20
0.30
0.40
1.00
* 0.501423.40
1432.18
1433.42
1434.51
1433.660.00
0.00
0.32
1.41
0.56257.
372.
397.
420.
1748.126.
511.
1194.
3671.
1748.0.00
0.00
2.17
7.58
1748.13.50
21.50
19.67
18.08
1748.0.00
0.00
0.00
0.00
0.00

PLAN 1

ELEVATION
STORAGE
OUTFLOWINITIAL VALUE
1345.80
121.
0.SPILLWAY CHEST
1345.80
121.
0.TOP OF DAM
1347.60
136.
378.RESERVOIR
No 2RATIO
OF
PMFMAXIMUM
RESERVOIR
W.S.ELEVMAXIMUM
DEPTH
OVER DAMMAXIMUM
STORAGE
AC-FTMAXIMUM
OUTFLOW
CFSDURATION
OVER TOP
HOURSTIME OF
MAX OUTFLOW
HOURSTIME OF
FAILURE
HOURS0.20
0.30
0.40
1.00
* 0.501346.87
1347.91
1348.47
1349.28
1346.60.00
0.31
0.87
1.68
1.00130.
139.
145.
460.
1270.181.
497.
1047.
2400.
1270.0.00
2.33
5.04
8.00
1270.16.75
21.92
20.33
20.58
1270.0.00
0.00
0.00
0.00
0.00

PLAN 1

ELEVATION
STORAGE
OUTFLOWINITIAL VALUE
1291.80
45.
0.SPILLWAY CHEST
1291.80
45.
0.TOP OF DAM
1294.30
56.
622.RESERVOIR
No 1RATIO
OF
PMFMAXIMUM
RESERVOIR
W.S.ELEVMAXIMUM
DEPTH
OVER DAMMAXIMUM
STORAGE
AC-FTMAXIMUM
OUTFLOW
CFSDURATION
OVER TOP
HOURSTIME OF
MAX OUTFLOW
HOURSTIME OF
FAILURE
HOURS0.20
0.30
0.40
1.00
* 0.501293.57
1294.10
1294.87
1295.94
1295.00.00
0.00
0.57
1.04
0.7053.
55.
58.
81.
1550.399.
551.
1242.
3068.
1550.0.00
0.00
5.25
9.50
1550.17.17
22.00
17.72
18.42
1550.0.00
0.00
0.00
0.00
0.00

* INTERPOLATED VALUES

SUBJECT

DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR No 1

Y WJV

DATE

2-6-79

PROJ. NO.

79-617-214

CHKD. BY

DATE

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OF

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Environmental SpecialistsSECTION 7
250 FT DS
OF DAM No 1

PLAN 1 STATION 107

| RATIO | MAXIMUM FLOW, CFS | MAXIMUM STAGE, FT | TIME HOURS |
|--------|----------------------|----------------------|---------------|
| .20 | 400. | 1254.0 | 17.17 |
| .30 | 551. | 1254.6 | 22.00 |
| .40 | 1243. | 1256.0 | 19.75 |
| 1.00 | 3058. | 1258.4 | 18.42 |
| * 0.50 | 1550. | 1256.6 | |

SECTION 8
1500 FT DS
OF DAM No 1

PLAN 1 STATION 708

| RATIO | MAXIMUM FLOW, CFS | MAXIMUM STAGE, FT | TIME HOURS |
|--------|----------------------|----------------------|---------------|
| .20 | 400. | 1208.4 | 17.17 |
| .30 | 551. | 1209.0 | 22.00 |
| .40 | 1246. | 1210.9 | 19.75 |
| 1.00 | 3067. | 1213.7 | 18.50 |
| * 0.50 | 1550. | 1211.7 | |

* INTERPOLATED VALUES

SUBJECT

DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR No 1

BY WJV

DATE

2-6-79

PROJ. NO.

79-617-214

HKD. BY

DATE

SHEET NO.

N

OF

Engineers • Geologists • Plann
Environmental SpecialistsBREACHING
ANALYSIS(SAME INPUT DATA
AS FOR THE OVERTOPPING
ANALYSIS W/ THE
ADDITION OF THE
BREACH CONDITIONS
GIVEN HERE)DAM SAFETY INSPECTION PENNSYLVANIA 214 AND 215
HUTCHINSON RESERVOIRS #1 AND #2 (W/ US ANALYSIS OF RESERVOIR #3)
BREACHING ANALYSIS

ROUTE THRU RESERVOIR #3

PLAN

| DAM DATA | |
|----------|------|
| TUPEL | CUOD |
| 1433.1 | 0.0 |
| | 0.0 |
| | 0.0 |

| DAM BREACH DATA | |
|-----------------|---------|
| BR#ID | Z |
| 0. | ELBM |
| | TFAIL |
| | .25 |
| | 1375.50 |
| | 1433.10 |

BEGIN DAM FAILURE AT 18.25 HOURS

PEAK OUTFLOW IS 19574. AT TIME 18.50 HOURS

①

| DAM BREACH DATA | |
|-----------------|---------|
| BR#ID | Z |
| 150. | ELBM |
| | TFAIL |
| | .25 |
| | 1375.50 |
| | 1433.10 |

BEGIN DAM FAILURE AT 18.25 HOURS

PEAK OUTFLOW IS 29691. AT TIME 18.37 HOURS

②

| DAM BREACH DATA | |
|-----------------|---------|
| BR#ID | Z |
| 0. | ELBM |
| | TFAIL |
| | 4.00 |
| | 1375.50 |
| | 1433.10 |

BEGIN DAM FAILURE AT 18.25 HOURS

PEAK OUTFLOW IS 3138. AT TIME 20.42 HOURS

③

| DAM BREACH DATA | |
|-----------------|---------|
| BR#ID | Z |
| 150. | ELBM |
| | TFAIL |
| | 4.00 |
| | 1375.50 |
| | 1433.10 |

BEGIN DAM FAILURE AT 18.25 HOURS

PEAK OUTFLOW IS 4330. AT TIME 18.75 HOURS

④

| DAM BREACH DATA | |
|-----------------|---------|
| BR#ID | Z |
| 100. | ELBM |
| | TFAIL |
| | 4.00 |
| | 1375.50 |
| | 1433.10 |

BEGIN DAM FAILURE AT 18.50 HOURS

PEAK OUTFLOW IS 5996. AT TIME 18.83 HOURS

⑤

| DAM BREACH DATA | |
|-----------------|---------|
| BR#ID | Z |
| 100. | ELBM |
| | TFAIL |
| | 2.00 |
| | 1375.50 |
| | 1433.10 |

BEGIN DAM FAILURE AT 18.25 HOURS

PEAK OUTFLOW IS 5997. AT TIME 18.63 HOURS

⑥

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR No 1
 BY WJV DATE 2-6-79 PROJ. NO. 79-617-214
 HKD. BY _____ DATE _____ SHEET NO. 0 OF _____

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THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .042 HOURS DURING BREACH FORMATION.
 DOWNSTREAM CALCULATIONS WILL USE A TIME INTERVAL OF .083 HOURS.
 THIS TABLE COMPARES THE HYDROGRAPH FOR DOWNSTREAM CALCULATIONS WITH THE COMPUTED BREACH HYDROGRAPH.
 INTERMEDIATE FLOWS ARE INTERPOLATED FROM END-OF-PERIOD VALUES.

| TIME (HOURS) | TIME FROM BEGINNING OF BREACH (HOURS) | INTERPOLATED BREACH HYDROGRAPH (CFS) | COMPUTED BREACH HYDROGRAPH (CFS) | ERROR (CFS) | ACCUMULATED ERROR (CFS) | ACCUMULATED ERROR (AC-FT) |
|-----------------|--|---|---|----------------|-------------------------------|---------------------------------|
| 18.250 | 0.000 | 851. | 851. | 0. | 0. | 0. |
| 18.292 | .042 | 1509. | 1380. | 129. | 129. | 0. |
| 18.333 | .083 | 4167. | -2167. -136. 91 | -0. | 129. | 0. |
| 18.375 | .125 | 2969. | 2969. | 0. | 129. | 0. |
| 18.417 | .167 | 3771. | 2982. -1558. 2317 | -13. | 116. | 0. |
| 18.458 | .208 | 4409. | -3771. 0. | 0. | 116. | 0. |
| 18.500 | .250 | 5046. | 4475. 0. | 0. | 50. | 0. |
| 18.542 | .292 | 5530. | -5046. -1616 3165 | -07. | 50. | 0. |
| 18.583 | .333 | 5982. | 5530. 0. | 0. | 33. | 0. |
| 18.625 | .375 | 5982. | -5982. -1731-4150 | -10. | 33. | 0. |
| 18.667 | .417 | 5941. | 5982. 0. | 0. | -2. | 0. |
| 18.708 | .458 | 5906. | -5941. -1146-4115 | -35. | -2. | 0. |
| 18.750 | .500 | 5871. | 5906. 0. | 0. | 3. | 0. |
| 18.792 | .542 | 5748. | -5871. -146. 415 | 5. | 3. | 0. |
| 18.833 | .583 | 5626. | 5748. 0. | 0. | 3. | 0. |
| 18.875 | .625 | 5553. | -5626. -174-2316 | -4. | -1. | 0. |
| 18.917 | .667 | 5480. | 5553. 0. | 0. | -1. | 0. |
| 18.958 | .708 | 5264. | -5480. -1821-3150 | 13. | 12. | 0. |
| 19.000 | .750 | 5048. | 5264. 0. | 0. | 12. | 0. |
| 19.042 | .792 | 4935. | -5048. -175-3143 | -5. | 7. | 0. |
| 19.083 | .833 | 4822. | 4935. 0. | 0. | 32. | 0. |
| 19.125 | .875 | 4773. | -4822. -116-3136 | 25. | 32. | 0. |
| 19.167 | .917 | 4724. | 4773. 0. | 0. | 41. | 0. |
| 19.208 | .958 | 4698. | -4724. APPROXIMATE | 9. | 41. | 0. |
| 19.250 | 1.000 | 4672. | 4698. 0. | 0. | 44. | 0. |
| 19.292 | 1.042 | 4504. | -4672. OUE TO | -9. | 44. | 0. |
| 19.333 | 1.083 | 4336. | 4504. 0. | 0. | 36. | 0. |
| 19.375 | 1.125 | 4251. | -4336. BREACH | -9. | 36. | 0. |
| 19.417 | 1.167 | 4166. | 4251. 0. | 0. | 36. | 0. |
| 19.458 | 1.208 | 3968. | -4166. 0. | 0. | 55. | 0. |
| 19.500 | 1.250 | 3769. | 3968. 0. | 0. | 55. | 0. |
| 19.542 | 1.292 | 3691. | -3769. 17. | 17. | 72. | 0. |
| 19.583 | 1.333 | 3613. | 3691. 0. | 0. | 72. | 0. |
| 19.625 | 1.375 | 3453. | -3613. 21. | 21. | 93. | 0. |
| 19.667 | 1.417 | 3292. | 3453. 0. | 0. | 93. | 0. |
| 19.708 | 1.458 | 3241. | -3292. 36. | 36. | 129. | 0. |
| 19.750 | 1.500 | 3190. | 3241. 0. | 0. | 129. | 0. |
| 19.792 | 1.542 | 3026. | -3190. 14. | 14. | 143. | 0. |
| 19.833 | 1.583 | 2862. | 3026. 0. | 0. | 143. | 0. |
| 19.875 | 1.625 | 2821. | -2862. 52. | 52. | 195. | 1. |
| 19.917 | 1.667 | 2780. | 2821. 0. | 0. | 195. | 1. |
| 19.958 | 1.708 | 2570. | -2780. 11. | 11. | 206. | 1. |
| 20.000 | 1.750 | 2361. | 2570. 0. | 0. | 206. | 1. |
| 20.042 | 1.792 | 2311. | -2361. 107. | 107. | 314. | 1. |
| 20.083 | 1.833 | 2261. | 2311. 0. | 0. | 314. | 1. |
| 20.125 | 1.875 | 2080. | -2261. -12. | -12. | 301. | 1. |
| 20.167 | 1.917 | 1859. | 2080. 0. | 0. | 301. | 1. |
| 20.208 | 1.958 | 1776. | -1859. 177. | 177. | 479. | 2. |
| 20.250 | 2.000 | 1693. | 1776. 0. | 0. | 479. | 2. |
| | | | -1693. -68. | -68. | 411. | 1. |

(5)

SUBJECT

DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR No 1

BY

WJV

DATE

2-6-79

PROJ. NO.

78-617-214

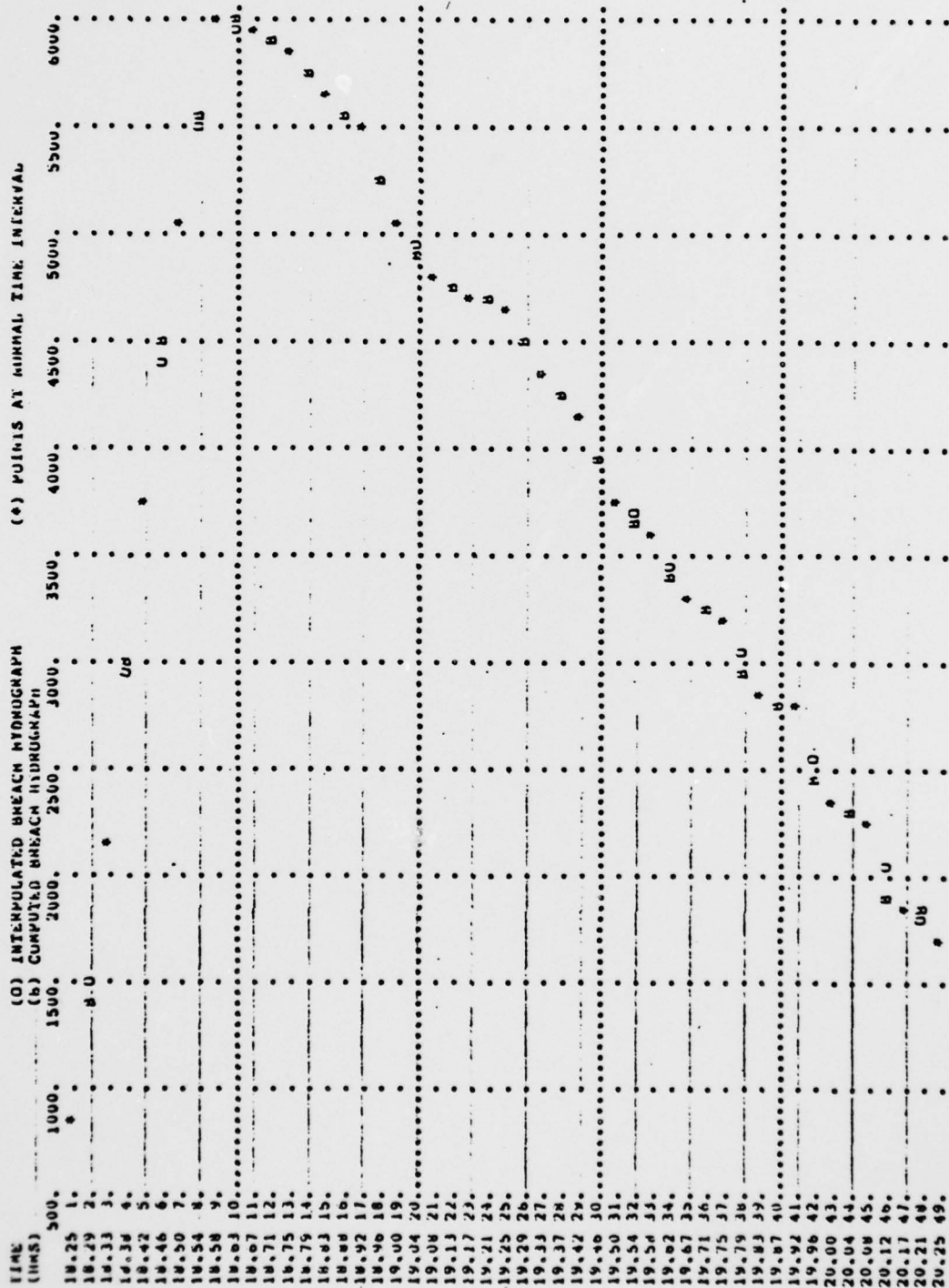
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SUBJECT

DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR No 1

BY WJV

DATE

2-6-79

PROJ. NO.

79-617-214

CHKD. BY

DATE

SHEET NO.

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ROUTE THRU RESERVOIR #2

| DAM DATA | | | |
|----------|-------|------|--------|
| TYPE | COORD | ELVD | DAM#ID |
| 1347.6 | 0.0 | 0.0 | 0. |

| DAM BREACH DATA | | | |
|-----------------|-----|---------|-------|
| BK#ID | Z | ELDM | TFAIL |
| 0. | .50 | 1300.60 | .25 |
| SEL#L FAILED | | | |
| 1345.80 1347.60 | | | |

BEGIN DAM FAILURE AT 18.17 HOURS

PEAK OUTFLOW IS 15532. AT TIME 18.58 HOURS

| DAM BREACH DATA | | | |
|-----------------|------|---------|-------|
| BK#ID | Z | ELDM | TFAIL |
| 100. | 4.00 | 1300.60 | .25 |
| SEL#L FAILED | | | |
| 1345.80 1347.60 | | | |

BEGIN DAM FAILURE AT 18.17 HOURS

PEAK OUTFLOW IS 32481. AT TIME 18.37 HOURS

| DAM BREACH DATA | | | |
|-----------------|-----|---------|-------|
| BK#ID | Z | ELDM | TFAIL |
| 0. | .50 | 1300.60 | 4.00 |
| SEL#L FAILED | | | |
| 1345.80 1347.60 | | | |

BEGIN DAM FAILURE AT 18.17 HOURS

PEAK OUTFLOW IS 3762. AT TIME 20.42 HOURS

| DAM BREACH DATA | | | |
|-----------------|------|---------|-------|
| BK#ID | Z | ELDM | TFAIL |
| 100. | 4.00 | 1300.60 | 4.00 |
| SEL#L FAILED | | | |
| 1345.80 1347.60 | | | |

BEGIN DAM FAILURE AT 18.17 HOURS

PEAK OUTFLOW IS 5255. AT TIME 18.75 HOURS

| DAM BREACH DATA | | | |
|-----------------|------|---------|-------|
| BK#ID | Z | ELDM | TFAIL |
| 50. | 1.00 | 1300.60 | 2.00 |
| SEL#L FAILED | | | |
| 1345.80 1348.10 | | | |

BEGIN DAM FAILURE AT 18.13 HOURS

PEAK OUTFLOW IS 7597. AT TIME 18.52 HOURS

| DAM BREACH DATA | | | |
|-----------------|------|---------|-------|
| BK#ID | Z | ELDM | TFAIL |
| 50. | 1.00 | 1300.60 | 2.00 |
| SEL#L FAILED | | | |
| 1345.80 1347.60 | | | |

BEGIN DAM FAILURE AT 18.17 HOURS

PEAK OUTFLOW IS 7734. AT TIME 18.75 HOURS

PLAN

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SUBJECT

DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR No 1

BY WJV

DATE

2-6-79

PROJ. NO. 79-617-214

CHKD. BY

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THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .042 HOURS DURING BREACH FORMATION.
DRAINAGE CALCULATIONS WILL USE A 100' INTERVAL OF .043 HOURS.
THIS TABLE COMPARES THE HYDROGRAPH FOR INSTANTANEOUS CALCULATIONS WITH THE COMPUTED BREACH HYDROGRAPH.
INSTANTANEOUS FLOWS ARE INTERPOLATED FROM END-OF-PERIOD VALUES.

| TIME (HOURS) | 100' FROM BEGINNING OF BREACH (HOURS) | INTERPOLATED BREACH HYDROGRAPH (CFS) | COMPUTED BREACH HYDROGRAPH (CFS) | ERROR (CFS) | ACCUMULATED ERROR (CFS) | ACCUMULATED ERROR (AC-FT) |
|-----------------|--|---|---|----------------|-------------------------------|---------------------------------|
| 18.167 | 0.000 | 461. | 461. (SEE SHEET 0) | 0. | 0. | 0. |
| 18.208 | .042 | 741. | 702. | 40. | 40. | 0. |
| 18.250 | .083 | 1022. | 1022. | 0. | 40. | 0. |
| 18.292 | .125 | 1498. | 1430. | 67. | 107. | 0. |
| 18.333 | .167 | 1974. | 1974. | 0. | 107. | 0. |
| 18.375 | .208 | 2745. | 2682. | 64. | 171. | 1. |
| 18.417 | .250 | 3517. | 3517. | 0. | 171. | 1. |
| 18.458 | .292 | 4324. | 4323. | 1. | 171. | 1. |
| 18.500 | .333 | 5131. | 5131. | 0. | 171. | 1. |
| 18.542 | .375 | 5850. | 5559. | 291. | 142. | 0. |
| 18.583 | .417 | 6569. | 6269. | 300. | 32. | 0. |
| 18.625 | .458 | 7008. | 7009. | -1. | 32. | 0. |
| 18.667 | .500 | 7447. | 7447. | 0. | 32. | 0. |
| 18.708 | .542 | 7891. | 7891. | 0. | 32. | 0. |
| 18.750 | .583 | 8331. | 8331. | 0. | 32. | 0. |
| 18.792 | .625 | 8771. | 8771. | 0. | 32. | 0. |
| 18.833 | .667 | 9211. | 9211. | 0. | 32. | 0. |
| 18.875 | .708 | 9651. | 9651. | 0. | 32. | 0. |
| 18.917 | .750 | 10091. | 10091. | 0. | 32. | 0. |
| 18.958 | .792 | 10531. | 10531. | 0. | 32. | 0. |
| 19.000 | .833 | 10971. | 10971. | 0. | 32. | 0. |
| 19.042 | .875 | 11411. | 11411. | 0. | 32. | 0. |
| 19.083 | .917 | 11851. | 11851. | 0. | 32. | 0. |
| 19.125 | .958 | 12291. | 12291. | 0. | 32. | 0. |
| 19.167 | 1.000 | 12731. | 12731. | 0. | 32. | 0. |
| 19.208 | 1.042 | 13171. | 13171. | 0. | 32. | 0. |
| 19.250 | 1.083 | 13611. | 13611. | 0. | 32. | 0. |
| 19.292 | 1.125 | 14051. | 14051. | 0. | 32. | 0. |
| 19.333 | 1.167 | 14491. | 14491. | 0. | 32. | 0. |
| 19.375 | 1.208 | 14931. | 14931. | 0. | 32. | 0. |
| 19.417 | 1.250 | 15371. | 15371. | 0. | 32. | 0. |
| 19.458 | 1.292 | 15811. | 15811. | 0. | 32. | 0. |
| 19.500 | 1.333 | 16251. | 16251. | 0. | 32. | 0. |
| 19.542 | 1.375 | 16691. | 16691. | 0. | 32. | 0. |
| 19.583 | 1.417 | 17131. | 17131. | 0. | 32. | 0. |
| 19.625 | 1.458 | 17571. | 17571. | 0. | 32. | 0. |
| 19.667 | 1.500 | 18011. | 18011. | 0. | 32. | 0. |
| 19.708 | 1.542 | 18451. | 18451. | 0. | 32. | 0. |
| 19.750 | 1.583 | 18891. | 18891. | 0. | 32. | 0. |
| 19.792 | 1.625 | 19331. | 19331. | 0. | 32. | 0. |
| 19.833 | 1.667 | 19771. | 19771. | 0. | 32. | 0. |
| 19.875 | 1.708 | 20211. | 20211. | 0. | 32. | 0. |
| 19.917 | 1.750 | 20651. | 20651. | 0. | 32. | 0. |
| 19.958 | 1.792 | 21091. | 21091. | 0. | 32. | 0. |
| 20.000 | 1.833 | 21531. | 21531. | 0. | 32. | 0. |
| 20.042 | 1.875 | 21971. | 21971. | 0. | 32. | 0. |
| 20.083 | 1.917 | 22411. | 22411. | 0. | 32. | 0. |
| 20.125 | 1.958 | 22851. | 22851. | 0. | 32. | 0. |
| 20.167 | 2.000 | 23291. | 23291. | 0. | 32. | 0. |

5

SUBJECT

DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR No 1

Y WJV

DATE

2-6-79

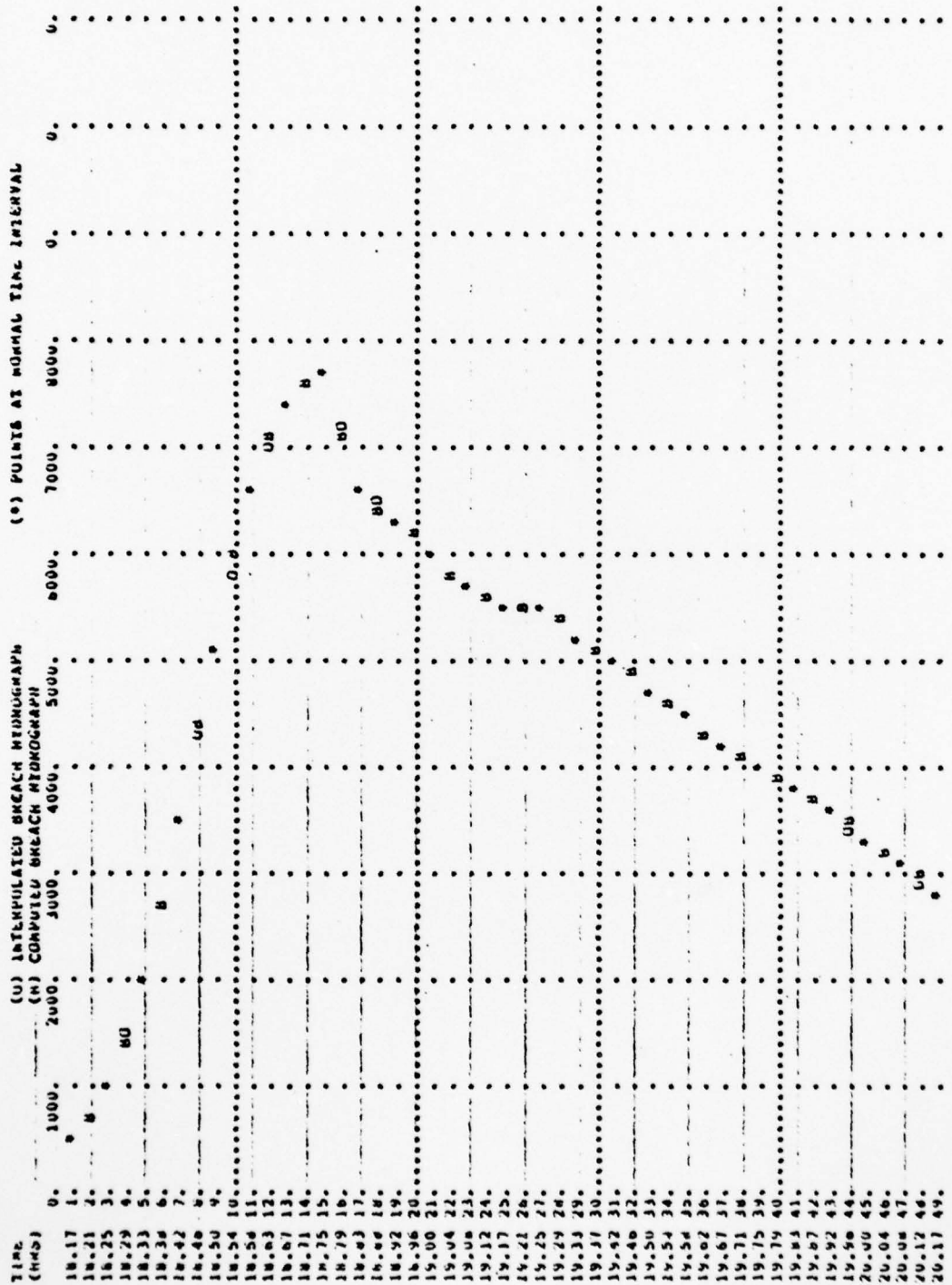
PROJ. NO.

79-617-214

CHKD. BY

DATE

SHEET NO.

5 OF**gai**
CONSULTANTS,Engineers • Geologists • Planner
Environmental Specialists

(5)

SUBJECT

DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR No 1

BY

WJV

DATE

2-6-79

PROJ. NO.

78-617-214

CD. BY

DATE

SHEET NO.

T OF



Engineers • Geologists • Planners
Environmental Specialists

ROUTE 1100 RESERVOIR #1

DAM DATA
TOPEL 1294.3 CUOD 6.0 EXPD 0.0 DAM#10 0.

DAM BREACH DATA
BREACH 2 ELUM 4.00 TRAIL 4.00 #SEL 1291.80 1294.30
0.0

BEGIN DAM FAILURE AT 16.25 HOURS

PEAK OUTFLOW IS 3927. AT TIME 20.50 HOURS

DAM BREACH DATA
BREACH 2 ELUM 4.00 TRAIL 4.00 #SEL 1291.80 1294.30
100.0

BEGIN DAM FAILURE AT 16.25 HOURS

PEAK OUTFLOW IS 5746. AT TIME 18.75 HOURS

DAM BREACH DATA
BREACH 2 ELUM 1.00 TRAIL 1.00 #SEL 1291.80 1294.80
50.0

BEGIN DAM FAILURE AT 18.42 HOURS

PEAK OUTFLOW IS 8479. AT TIME 18.90 HOURS

DAM BREACH DATA
BREACH 2 ELUM 0.25 TRAIL 0.25 #SEL 1291.80 1294.30
0.0

BEGIN DAM FAILURE AT 16.25 HOURS

PEAK OUTFLOW IS 13715. AT TIME 18.50 HOURS

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SUBJECT

DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR No 1

BY WJV

DATE 2-6-79

PROJ. NO. 79-617-214

KD. BY

DATE

SHEET NO. U OF

Engineers • Geologists • Planners
Environmental Specialists

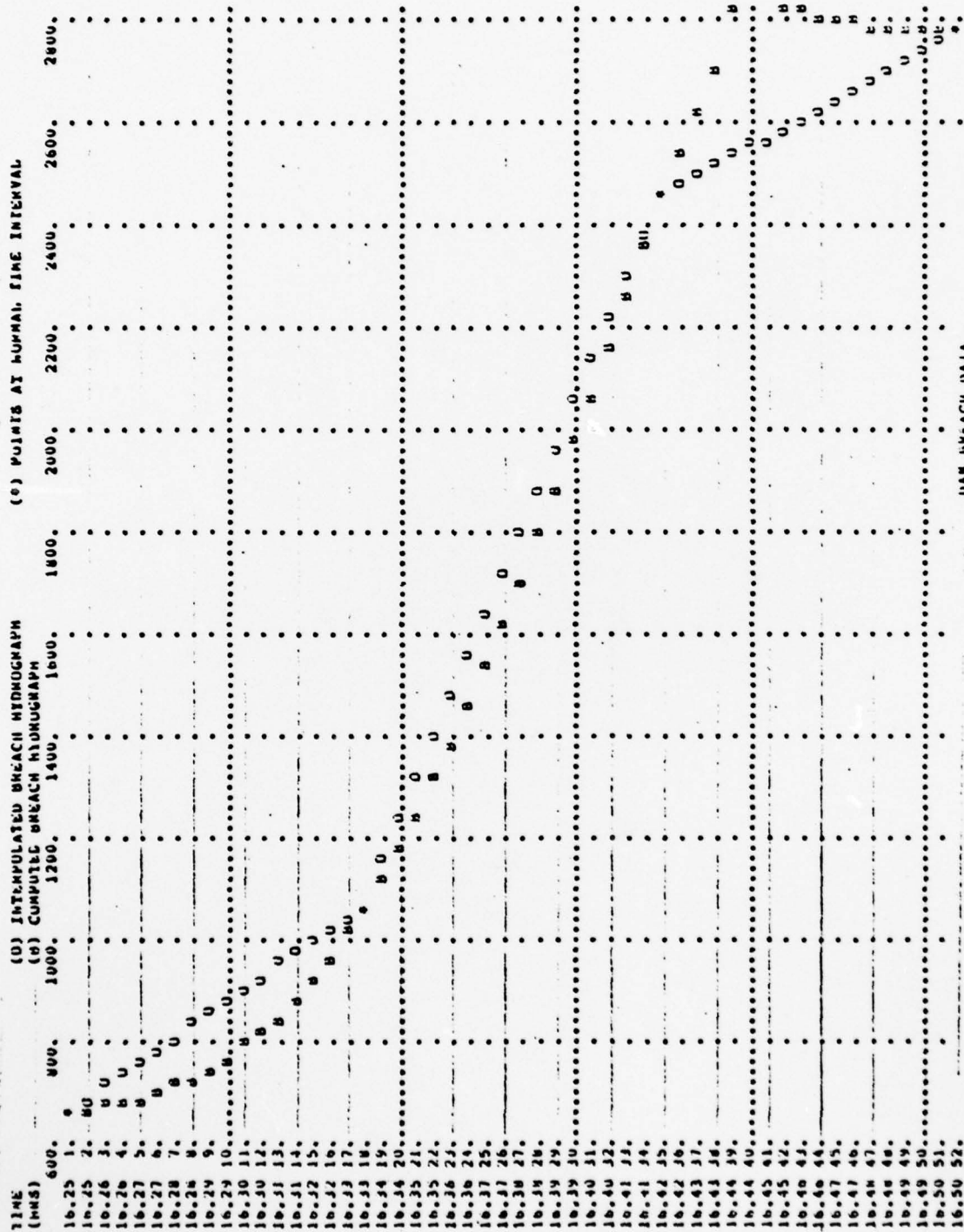
THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .005 HOURS DURING BREACH FORMATION.
DURING BREACH CALCULATIONS ALSO USE A TIME INTERVAL OF .005 HOURS.
THIS TABLE COMPARES THE HYDROGRAPH FOR DOWNSTREAM CALCULATIONS WITH THE COMPUTED BREACH HYDROGRAPH.
INTERMEDIATE VALUES ARE INTERPOLATED FROM END-OF-PERIOD VALUES.

| TIME (HOURS) | TIME FROM BEGINNING OF BREACH (HOURS) | INTERPOLATED BREACH HYDROGRAPH (CFS) | COMPUTED BREACH HYDROGRAPH (CFS) | ERROR (CFS) | ACCUMULATED ERROR (CFS) | ACCUMULATED ERROR (AC-FT) |
|-----------------|--|---|---|----------------|-------------------------------|---------------------------------|
| 16.250 | 0.000 | 662. | 662. | 0. | 0. | 0. |
| 16.255 | .005 | 666. | 666. | 0. | 0. | 0. |
| 16.260 | .010 | 670. | 670. | 0. | 0. | 0. |
| 16.265 | .015 | 674. | 674. | 0. | 0. | 0. |
| 16.270 | .020 | 678. | 678. | 0. | 0. | 0. |
| 16.275 | .025 | 682. | 682. | 0. | 0. | 0. |
| 16.279 | .029 | 686. | 686. | 0. | 0. | 0. |
| 16.284 | .034 | 690. | 690. | 0. | 0. | 0. |
| 16.289 | .039 | 694. | 694. | 0. | 0. | 0. |
| 16.294 | .044 | 698. | 698. | 0. | 0. | 0. |
| 16.299 | .049 | 702. | 702. | 0. | 0. | 0. |
| 16.304 | .054 | 706. | 706. | 0. | 0. | 0. |
| 16.309 | .059 | 710. | 710. | 0. | 0. | 0. |
| 16.314 | .064 | 714. | 714. | 0. | 0. | 0. |
| 16.319 | .069 | 718. | 718. | 0. | 0. | 0. |
| 16.324 | .074 | 722. | 722. | 0. | 0. | 0. |
| 16.328 | .078 | 726. | 726. | 0. | 0. | 0. |
| 16.333 | .083 | 730. | 730. | 0. | 0. | 0. |
| 16.338 | .088 | 734. | 734. | 0. | 0. | 0. |
| 16.343 | .093 | 738. | 738. | 0. | 0. | 0. |
| 16.348 | .098 | 742. | 742. | 0. | 0. | 0. |
| 16.353 | .103 | 746. | 746. | 0. | 0. | 0. |
| 16.358 | .108 | 750. | 750. | 0. | 0. | 0. |
| 16.363 | .113 | 754. | 754. | 0. | 0. | 0. |
| 16.368 | .118 | 758. | 758. | 0. | 0. | 0. |
| 16.373 | .123 | 762. | 762. | 0. | 0. | 0. |
| 16.377 | .127 | 766. | 766. | 0. | 0. | 0. |
| 16.382 | .132 | 770. | 770. | 0. | 0. | 0. |
| 16.387 | .137 | 774. | 774. | 0. | 0. | 0. |
| 16.392 | .142 | 778. | 778. | 0. | 0. | 0. |
| 16.397 | .147 | 782. | 782. | 0. | 0. | 0. |
| 16.402 | .152 | 786. | 786. | 0. | 0. | 0. |
| 16.407 | .157 | 790. | 790. | 0. | 0. | 0. |
| 16.412 | .162 | 794. | 794. | 0. | 0. | 0. |
| 16.417 | .167 | 798. | 798. | 0. | 0. | 0. |
| 16.422 | .172 | 802. | 802. | 0. | 0. | 0. |
| 16.426 | .176 | 806. | 806. | 0. | 0. | 0. |
| 16.431 | .181 | 810. | 810. | 0. | 0. | 0. |
| 16.436 | .186 | 814. | 814. | 0. | 0. | 0. |
| 16.441 | .191 | 818. | 818. | 0. | 0. | 0. |
| 16.446 | .196 | 822. | 822. | 0. | 0. | 0. |
| 16.451 | .201 | 826. | 826. | 0. | 0. | 0. |
| 16.456 | .206 | 830. | 830. | 0. | 0. | 0. |
| 16.461 | .211 | 834. | 834. | 0. | 0. | 0. |
| 16.466 | .216 | 838. | 838. | 0. | 0. | 0. |
| 16.471 | .221 | 842. | 842. | 0. | 0. | 0. |
| 16.475 | .225 | 846. | 846. | 0. | 0. | 0. |
| 16.480 | .230 | 850. | 850. | 0. | 0. | 0. |
| 16.485 | .235 | 854. | 854. | 0. | 0. | 0. |
| 16.490 | .240 | 858. | 858. | 0. | 0. | 0. |
| 16.495 | .245 | 862. | 862. | 0. | 0. | 0. |
| 16.500 | .250 | 866. | 866. | 0. | 0. | 0. |
| 16.505 | .255 | 870. | 870. | 0. | 0. | 0. |
| 16.510 | .260 | 874. | 874. | 0. | 0. | 0. |
| 16.515 | .265 | 878. | 878. | 0. | 0. | 0. |
| 16.520 | .270 | 882. | 882. | 0. | 0. | 0. |
| 16.525 | .275 | 886. | 886. | 0. | 0. | 0. |
| 16.530 | .280 | 890. | 890. | 0. | 0. | 0. |
| 16.535 | .285 | 894. | 894. | 0. | 0. | 0. |
| 16.540 | .290 | 898. | 898. | 0. | 0. | 0. |
| 16.545 | .295 | 902. | 902. | 0. | 0. | 0. |
| 16.550 | .300 | 906. | 906. | 0. | 0. | 0. |
| 16.555 | .305 | 910. | 910. | 0. | 0. | 0. |
| 16.560 | .310 | 914. | 914. | 0. | 0. | 0. |
| 16.565 | .315 | 918. | 918. | 0. | 0. | 0. |
| 16.570 | .320 | 922. | 922. | 0. | 0. | 0. |
| 16.575 | .325 | 926. | 926. | 0. | 0. | 0. |
| 16.580 | .330 | 930. | 930. | 0. | 0. | 0. |
| 16.585 | .335 | 934. | 934. | 0. | 0. | 0. |
| 16.590 | .340 | 938. | 938. | 0. | 0. | 0. |
| 16.595 | .345 | 942. | 942. | 0. | 0. | 0. |
| 16.600 | .350 | 946. | 946. | 0. | 0. | 0. |
| 16.605 | .355 | 950. | 950. | 0. | 0. | 0. |
| 16.610 | .360 | 954. | 954. | 0. | 0. | 0. |
| 16.615 | .365 | 958. | 958. | 0. | 0. | 0. |
| 16.620 | .370 | 962. | 962. | 0. | 0. | 0. |
| 16.625 | .375 | 966. | 966. | 0. | 0. | 0. |
| 16.630 | .380 | 970. | 970. | 0. | 0. | 0. |
| 16.635 | .385 | 974. | 974. | 0. | 0. | 0. |
| 16.640 | .390 | 978. | 978. | 0. | 0. | 0. |
| 16.645 | .395 | 982. | 982. | 0. | 0. | 0. |
| 16.650 | .400 | 986. | 986. | 0. | 0. | 0. |
| 16.655 | .405 | 990. | 990. | 0. | 0. | 0. |
| 16.660 | .410 | 994. | 994. | 0. | 0. | 0. |
| 16.665 | .415 | 998. | 998. | 0. | 0. | 0. |
| 16.670 | .420 | 1002. | 1002. | 0. | 0. | 0. |
| 16.675 | .425 | 1006. | 1006. | 0. | 0. | 0. |
| 16.680 | .430 | 1010. | 1010. | 0. | 0. | 0. |
| 16.685 | .435 | 1014. | 1014. | 0. | 0. | 0. |
| 16.690 | .440 | 1018. | 1018. | 0. | 0. | 0. |
| 16.695 | .445 | 1022. | 1022. | 0. | 0. | 0. |
| 16.700 | .450 | 1026. | 1026. | 0. | 0. | 0. |
| 16.705 | .455 | 1030. | 1030. | 0. | 0. | 0. |
| 16.710 | .460 | 1034. | 1034. | 0. | 0. | 0. |
| 16.715 | .465 | 1038. | 1038. | 0. | 0. | 0. |
| 16.720 | .470 | 1042. | 1042. | 0. | 0. | 0. |
| 16.725 | .475 | 1046. | 1046. | 0. | 0. | 0. |
| 16.730 | .480 | 1050. | 1050. | 0. | 0. | 0. |
| 16.735 | .485 | 1054. | 1054. | 0. | 0. | 0. |
| 16.740 | .490 | 1058. | 1058. | 0. | 0. | 0. |
| 16.745 | .495 | 1062. | 1062. | 0. | 0. | 0. |
| 16.750 | .500 | 1066. | 1066. | 0. | 0. | 0. |
| 16.755 | .505 | 1070. | 1070. | 0. | 0. | 0. |
| 16.760 | .510 | 1074. | 1074. | 0. | 0. | 0. |
| 16.765 | .515 | 1078. | 1078. | 0. | 0. | 0. |
| 16.770 | .520 | 1082. | 1082. | 0. | 0. | 0. |
| 16.775 | .525 | 1086. | 1086. | 0. | 0. | 0. |
| 16.780 | .530 | 1090. | 1090. | 0. | 0. | 0. |
| 16.785 | .535 | 1094. | 1094. | 0. | 0. | 0. |
| 16.790 | .540 | 1098. | 1098. | 0. | 0. | 0. |
| 16.795 | .545 | 1102. | 1102. | 0. | 0. | 0. |
| 16.800 | .550 | 1106. | 1106. | 0. | 0. | 0. |
| 16.805 | .555 | 1110. | 1110. | 0. | 0. | 0. |
| 16.810 | .560 | 1114. | 1114. | 0. | 0. | 0. |
| 16.815 | .565 | 1118. | 1118. | 0. | 0. | 0. |
| 16.820 | .570 | 1122. | 1122. | 0. | 0. | 0. |
| 16.825 | .575 | 1126. | 1126. | 0. | 0. | 0. |
| 16.830 | .580 | 1130. | 1130. | 0. | 0. | 0. |
| 16.835 | .585 | 1134. | 1134. | 0. | 0. | 0. |
| 16.840 | .590 | 1138. | 1138. | 0. | 0. | 0. |
| 16.845 | .595 | 1142. | 1142. | 0. | 0. | 0. |
| 16.850 | .600 | 1146. | 1146. | 0. | 0. | 0. |
| 16.855 | .605 | 1150. | 1150. | 0. | 0. | 0. |
| 16.860 | .610 | 1154. | 1154. | 0. | 0. | 0. |
| 16.865 | .615 | 1158. | 1158. | 0. | 0. | 0. |
| 16.870 | .620 | 1162. | 1162. | 0. | 0. | 0. |
| 16.875 | .625 | 1166. | 1166. | 0. | 0. | 0. |
| 16.880 | .630 | 1170. | 1170. | 0. | 0. | 0. |
| 16.885 | .635 | 1174. | 1174. | 0. | 0. | 0. |
| 16.890 | .640 | 1178. | 1178. | 0. | 0. | 0. |
| 16.895 | .645 | 1182. | 1182. | 0. | 0. | 0. |
| 16.900 | .650 | 1186. | 1186. | 0. | 0. | 0. |
| 16.905 | .655 | 1190. | 1190. | 0. | 0. | 0. |
| 16.910 | .660 | 1194. | 1194. | 0. | 0. | 0. |
| 16.915 | .665 | 1198. | 1198. | 0. | 0. | 0. |
| 16.920 | .670 | 1202. | 1202. | 0. | 0. | 0. |
| 16.925 | .675 | 1206. | 1206. | 0. | 0. | 0. |
| 16.930 | .680 | 1210. | 1210. | 0. | 0. | 0. |
| 16.935 | .685 | 1214. | 1214. | 0. | 0. | 0. |
| 16.940 | .690 | 1218. | 1218. | 0. | 0. | 0. |
| 16.945 | .695 | 1222. | 1222. | 0. | 0. | 0. |
| 16.950 | .700 | 1226. | 1226. | 0. | 0. | 0. |
| 16.955 | .705 | 1230. | 1230. | 0. | 0. | 0. |
| 16.960 | .710 | 1234. | 1234. | 0. | 0. | 0. |
| 16.965 | .715 | 1238. | 1238. | 0. | 0. | 0. |
| 16.970 | .720 | 1242. | 1242. | 0. | 0. | 0. |
| 16.975 | .725 | 1246. | 1246. | 0. | 0. | 0. |
| 16.980 | .730 | 1250. | 1250. | 0. | 0. | 0. |
| 16.985 | .735 | 1254. | 1254. | 0. | 0. | 0. |
| 16.990 | .740 | 1258. | 1258. | 0. | 0. | 0. |
| 16.995 | .745 | 1262. | 1262. | 0. | 0. | 0. |
| 17.000 | .750 | 1266. | 1266. | 0. | 0. | 0. |

2691. OF DAM -176.
2810. AFTER 2813.
2817. 2817.
2818. 2818.
2819. 2819.
2820. 2820.
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2823. 2823.
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2851. 2851.
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2856. 2856.
2857. 2857.
2858. 2858.
2859. 2859.
2860. 2860.
2861. 2861.
2862. 2862.
2863. 2863.
2864. 2864.
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2990. 2990.
2991. 2991.
2992. 2992.
2993. 2993.
2994. 2994.
2995. 2995.
2996. 2996.
2997. 2997.
2998. 2998.
2999. 2999.
3000. 3000.

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR No 1
 BY WJV DATE 2-6-79 PROJ. NO. 79-617-214
 MKD. BY _____ DATE _____ SHEET NO. V OF _____

JCU CONSULTANTS,
 Engineers • Geologists • Planners
 Environmental Specialists



DAM BREACH DATA
 BREACH 2 ELONG TRAIL 251.80 1294.30
 100. 2.50 1261.30 .25

BEGIN DAM FAILURE AT 16:25 HOURS
 PEAK OUTFLOW IS 3396 cfs AT TIME 16:42 HOURS

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SUBJECT

DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR No 1

BY WJV

DATE

2-6-79

PROJ. NO.

73-617-214

KD. BY

DATE

SHEET NO.

W

OF

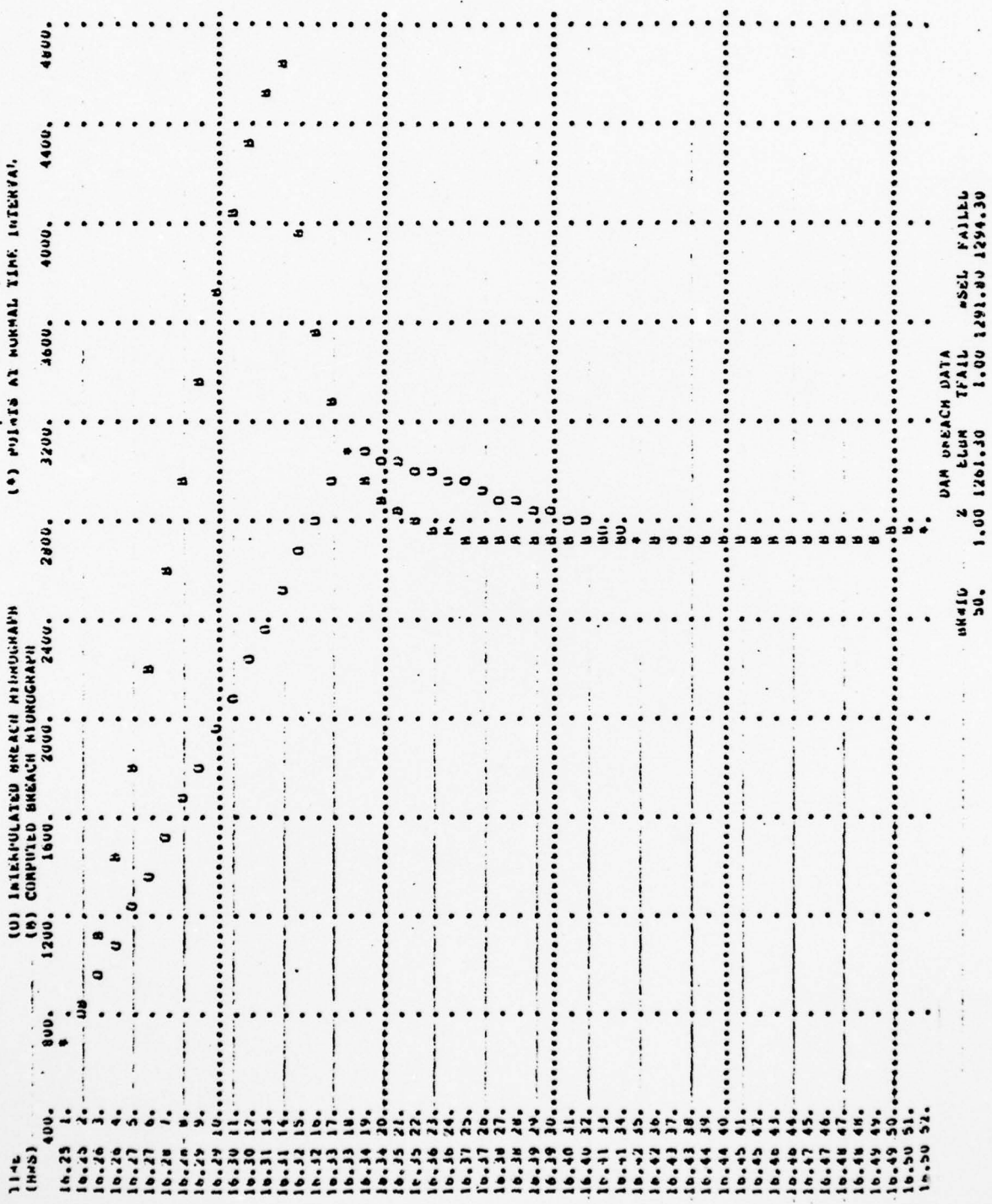
Engineers • Geologists • Planners
Environmental Specialists

THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .005 HOURS DURING BREACH FORMATION.
DURING BREACH CALCULATIONS WILL USE A TIME INTERVAL OF .005 HOURS.
THIS TABLE COMPARES THE HYDROGRAPH FOR DOWNSTREAM CALCULATIONS WITH THE COMPUTED BREACH HYDROGRAPH.
INTERPOLATED VALUES ARE INTERPOLATED FROM EXISTING VALUES.

| TIME (HOURS) | TIME FROM BEGINNING OF BREACH (HOURS) | INTERPOLATED BREACH HYDROGRAPH (CFS) | COMPUTED BREACH HYDROGRAPH (CFS) | ENRUR (CFS) | ACCUMULATED ENRUR (CFS) | ACCUMULATED ENRUR (AC-FT) |
|-----------------|--|---|---|----------------|-------------------------------|---------------------------------|
| 16.250 | 0.000 | 663. | 663. | 0. | 0. | 0. |
| 16.255 | .005 | 806. | 831. | -25. | -25. | -0. |
| 16.260 | .010 | 949. | 1102. | -154. | -154. | -0. |
| 16.265 | .015 | 1092. | 1439. | -347. | -347. | -0. |
| 16.270 | .020 | 1235. | 1809. | -574. | -574. | -0. |
| 16.275 | .025 | 1378. | 2190. | -811. | -811. | -1. |
| 16.279 | .029 | 1521. | 2585. | -1004. | -1004. | -1. |
| 16.284 | .034 | 1664. | 2975. | -1310. | -1310. | -2. |
| 16.289 | .039 | 1808. | 3349. | -1542. | -1542. | -2. |
| 16.294 | .044 | 1951. | 3707. | -1756. | -1756. | -3. |
| 16.299 | .049 | 2094. | 4033. | -1940. | -1940. | -4. |
| 16.304 | .054 | 2237. | 4322. | -2095. | -2095. | -5. |
| 16.309 | .059 | 2380. | 4571. | -2147. | -2147. | -6. |
| 16.314 | .064 | 2523. | 4799. | -2184. | -2184. | -6. |
| 16.319 | .069 | 2666. | 5005. | -1900. | -1900. | -7. |
| 16.324 | .074 | 2809. | 5211. | -744. | -744. | -7. |
| 16.328 | .078 | 2952. | 5427. | -744. | -744. | -7. |
| 16.333 | .083 | 3095. | 5639. | 0. | 0. | -7. |
| 16.338 | .088 | 3238. | 5851. | 100. | 100. | -7. |
| 16.343 | .093 | 3381. | 6063. | 101. | 101. | -7. |
| 16.348 | .098 | 3524. | 6275. | 195. | 195. | -7. |
| 16.353 | .103 | 3667. | 6487. | 214. | 214. | -7. |
| 16.358 | .108 | 3810. | 6699. | 217. | 217. | -7. |
| 16.363 | .113 | 3953. | 6911. | 214. | 214. | -7. |
| 16.368 | .118 | 4096. | 7123. | 204. | 204. | -7. |
| 16.373 | .123 | 4239. | 7335. | 190. | 190. | -7. |
| 16.378 | .128 | 4382. | 7547. | 173. | 173. | -7. |
| 16.383 | .133 | 4525. | 7759. | 155. | 155. | -7. |
| 16.388 | .138 | 4668. | 7971. | 135. | 135. | -7. |
| 16.393 | .143 | 4811. | 8183. | 113. | 113. | -7. |
| 16.398 | .148 | 4954. | 8395. | 91. | 91. | -7. |
| 16.403 | .153 | 5097. | 8607. | 69. | 69. | -6. |
| 16.408 | .158 | 5240. | 8819. | 46. | 46. | -6. |
| 16.413 | .163 | 5383. | 9031. | 23. | 23. | -6. |
| 16.418 | .168 | 5526. | 9243. | 0. | 0. | -6. |
| 16.423 | .173 | 5669. | 9455. | 0. | 0. | -6. |
| 16.428 | .178 | 5812. | 9667. | 0. | 0. | -6. |
| 16.433 | .183 | 5955. | 9879. | 0. | 0. | -6. |
| 16.438 | .188 | 6098. | 10091. | 0. | 0. | -6. |
| 16.443 | .193 | 6241. | 10303. | 0. | 0. | -6. |
| 16.448 | .198 | 6384. | 10515. | 0. | 0. | -6. |
| 16.453 | .203 | 6527. | 10727. | 0. | 0. | -6. |
| 16.458 | .208 | 6670. | 10939. | 0. | 0. | -6. |
| 16.463 | .213 | 6813. | 11151. | 0. | 0. | -6. |
| 16.468 | .218 | 6956. | 11363. | 0. | 0. | -6. |
| 16.473 | .223 | 7099. | 11575. | 0. | 0. | -6. |
| 16.478 | .228 | 7242. | 11787. | 0. | 0. | -6. |
| 16.483 | .233 | 7385. | 11999. | 0. | 0. | -6. |
| 16.488 | .238 | 7528. | 12211. | 0. | 0. | -6. |
| 16.493 | .243 | 7671. | 12423. | 0. | 0. | -6. |
| 16.498 | .248 | 7814. | 12635. | 0. | 0. | -6. |
| 16.503 | .253 | 7957. | 12847. | 0. | 0. | -6. |
| 16.508 | .258 | 8100. | 13059. | 0. | 0. | -6. |
| 16.513 | .263 | 8243. | 13271. | 0. | 0. | -6. |
| 16.518 | .268 | 8386. | 13483. | 0. | 0. | -6. |
| 16.523 | .273 | 8529. | 13695. | 0. | 0. | -6. |
| 16.528 | .278 | 8672. | 13907. | 0. | 0. | -6. |
| 16.533 | .283 | 8815. | 14119. | 0. | 0. | -6. |
| 16.538 | .288 | 8958. | 14331. | 0. | 0. | -6. |
| 16.543 | .293 | 9101. | 14543. | 0. | 0. | -6. |
| 16.548 | .298 | 9244. | 14755. | 0. | 0. | -6. |
| 16.553 | .303 | 9387. | 14967. | 0. | 0. | -6. |
| 16.558 | .308 | 9530. | 15179. | 0. | 0. | -6. |
| 16.563 | .313 | 9673. | 15391. | 0. | 0. | -6. |
| 16.568 | .318 | 9816. | 15603. | 0. | 0. | -6. |
| 16.573 | .323 | 9959. | 15815. | 0. | 0. | -6. |
| 16.578 | .328 | 10102. | 16027. | 0. | 0. | -6. |
| 16.583 | .333 | 10245. | 16239. | 0. | 0. | -6. |
| 16.588 | .338 | 10388. | 16451. | 0. | 0. | -6. |
| 16.593 | .343 | 10531. | 16663. | 0. | 0. | -6. |
| 16.598 | .348 | 10674. | 16875. | 0. | 0. | -6. |
| 16.603 | .353 | 10817. | 17087. | 0. | 0. | -6. |
| 16.608 | .358 | 10960. | 17299. | 0. | 0. | -6. |
| 16.613 | .363 | 11103. | 17511. | 0. | 0. | -6. |
| 16.618 | .368 | 11246. | 17723. | 0. | 0. | -6. |
| 16.623 | .373 | 11389. | 17935. | 0. | 0. | -6. |
| 16.628 | .378 | 11532. | 18147. | 0. | 0. | -6. |
| 16.633 | .383 | 11675. | 18359. | 0. | 0. | -6. |
| 16.638 | .388 | 11818. | 18571. | 0. | 0. | -6. |
| 16.643 | .393 | 11961. | 18783. | 0. | 0. | -6. |
| 16.648 | .398 | 12104. | 18995. | 0. | 0. | -6. |
| 16.653 | .403 | 12247. | 19207. | 0. | 0. | -6. |
| 16.658 | .408 | 12390. | 19419. | 0. | 0. | -6. |
| 16.663 | .413 | 12533. | 19631. | 0. | 0. | -6. |
| 16.668 | .418 | 12676. | 19843. | 0. | 0. | -6. |
| 16.673 | .423 | 12819. | 20055. | 0. | 0. | -6. |
| 16.678 | .428 | 12962. | 20267. | 0. | 0. | -6. |
| 16.683 | .433 | 13105. | 20479. | 0. | 0. | -6. |
| 16.688 | .438 | 13248. | 20691. | 0. | 0. | -6. |
| 16.693 | .443 | 13391. | 20903. | 0. | 0. | -6. |
| 16.698 | .448 | 13534. | 21115. | 0. | 0. | -6. |
| 16.703 | .453 | 13677. | 21327. | 0. | 0. | -6. |
| 16.708 | .458 | 13820. | 21539. | 0. | 0. | -6. |
| 16.713 | .463 | 13963. | 21751. | 0. | 0. | -6. |
| 16.718 | .468 | 14106. | 21963. | 0. | 0. | -6. |
| 16.723 | .473 | 14249. | 22175. | 0. | 0. | -6. |
| 16.728 | .478 | 14392. | 22387. | 0. | 0. | -6. |
| 16.733 | .483 | 14535. | 22599. | 0. | 0. | -6. |
| 16.738 | .488 | 14678. | 22811. | 0. | 0. | -6. |
| 16.743 | .493 | 14821. | 23023. | 0. | 0. | -6. |
| 16.748 | .498 | 14964. | 23235. | 0. | 0. | -6. |
| 16.753 | .503 | 15107. | 23447. | 0. | 0. | -6. |
| 16.758 | .508 | 15250. | 23659. | 0. | 0. | -6. |
| 16.763 | .513 | 15393. | 23871. | 0. | 0. | -6. |
| 16.768 | .518 | 15536. | 24083. | 0. | 0. | -6. |
| 16.773 | .523 | 15679. | 24295. | 0. | 0. | -6. |
| 16.778 | .528 | 15822. | 24507. | 0. | 0. | -6. |
| 16.783 | .533 | 15965. | 24719. | 0. | 0. | -6. |
| 16.788 | .538 | 16108. | 24931. | 0. | 0. | -6. |
| 16.793 | .543 | 16251. | 25143. | 0. | 0. | -6. |
| 16.798 | .548 | 16394. | 25355. | 0. | 0. | -6. |
| 16.803 | .553 | 16537. | 25567. | 0. | 0. | -6. |
| 16.808 | .558 | 16680. | 25779. | 0. | 0. | -6. |
| 16.813 | .563 | 16823. | 25991. | 0. | 0. | -6. |
| 16.818 | .568 | 16966. | 26203. | 0. | 0. | -6. |
| 16.823 | .573 | 17109. | 26415. | 0. | 0. | -6. |
| 16.828 | .578 | 17252. | 26627. | 0. | 0. | -6. |
| 16.833 | .583 | 17395. | 26839. | 0. | 0. | -6. |
| 16.838 | .588 | 17538. | 27051. | 0. | 0. | -6. |
| 16.843 | .593 | 17681. | 27263. | 0. | 0. | -6. |
| 16.848 | .598 | 17824. | 27475. | 0. | 0. | -6. |
| 16.853 | .603 | 17967. | 27687. | 0. | 0. | -6. |
| 16.858 | .608 | 18110. | 27899. | 0. | 0. | -6. |
| 16.863 | .613 | 18253. | 28111. | 0. | 0. | -6. |
| 16.868 | .618 | 18396. | 28323. | 0. | 0. | -6. |
| 16.873 | .623 | 18539. | 28535. | 0. | 0. | -6. |
| 16.878 | .628 | 18682. | 28747. | 0. | 0. | -6. |
| 16.883 | .633 | 18825. | 28959. | 0. | 0. | -6. |
| 16.888 | .638 | 18968. | 29171. | 0. | 0. | -6. |
| 16.893 | .643 | 19111. | 29383. | 0. | 0. | -6. |
| 16.898 | .648 | 19254. | 29595. | 0. | 0. | -6. |
| 16.903 | .653 | 19397. | 29807. | 0. | 0. | -6. |
| 16.908 | .658 | 19540. | 30019. | 0. | 0. | -6. |
| 16.913 | .663 | 19683. | 30231. | 0. | 0. | -6. |
| 16.918 | .668 | 19826. | 30443. | 0. | 0. | -6. |
| 16.923 | .673 | 19969. | 30655. | 0. | 0. | -6. |
| 16.928 | .678 | 20112. | 30867. | 0. | 0. | -6. |
| 16.933 | .683 | 20255. | 31079. | 0. | 0. | -6. |
| 16.938 | .688 | 20398. | 31291. | 0. | 0. | -6. |
| 16.943 | .693 | 20541. | 31503. | 0. | 0. | -6. |
| 16.948 | .698 | 20684. | 31715. | 0. | 0. | -6. |
| 16.953 | .703 | 20827. | 31927. | 0. | 0. | -6. |
| 16.958 | .708 | 20970. | 32139. | 0. | 0. | -6. |
| 16.963 | .713 | 21113. | 32351. | 0. | 0. | -6. |
| 16.968 | .718 | 21256. | 32563. | 0. | 0. | -6. |
| 16.973 | .723 | 21399. | 32775. | 0. | 0. | -6. |
| 16.978 | .728 | 21542. | 32987. | 0. | 0. | -6. |
| 16.983 | .733 | 21685. | 33199. | 0. | 0. | -6. |
| 16.988 | .738 | 21828. | 33411. | 0. | 0. | -6. |
| 16.993 | .743 | 21971. | 33623. | 0. | 0. | -6. |
| 16.998 | .748 | 22114. | 33835. | 0. | 0. | -6. |
| 17.003 | .753 | 22257. | 34047. | 0. | 0. | -6. |
| 17.008 | .758 | 22400. | 34259. | 0. | 0. | -6. |
| 17.013 | .763 | 22543. | 34471. | 0. | 0. | -6. |
| 17.018 | .768 | 22686. | 34683. | 0. | 0. | -6. |
| 17.023 | .773 | 22829. | 34895. | 0. | 0. | -6. |
| 17.028 | .778 | 22972. | 35107. | 0. | 0. | -6. |
| 17.033 | .783 | 23115. | 35319. | 0. | 0. | -6. |
| 17.038 | .788 | 23258. | 35531. | 0. | 0. | -6. |
| 17.043 | .793 | 23401. | 35743. | 0. | 0. | -6. |
| 17.048 | .798 | 23544. | 35955. | 0. | 0. | -6. |
| 17.053 | .803 | 23687. | 36167. | 0. | 0. | -6. |
| 17.058 | .808 | 23830. | 36379. | 0. | 0. | -6. |
| 17.063 | .813 | 23973. | 36591. | 0. | 0. | -6. |
| 17.068 | .818 | 24116. | 36803. | 0. | 0. | -6. |
| 17.073 | .823 | 24259. | 37015. | 0. | 0. | -6. |
| 17.078 | .828 | 24402. | 37227. | 0. | 0. | -6. |
| 17.083 | .833 | 24545. | 37439. | 0. | 0. | -6. |
| 17.088 | .838 | 24688. | 37651. | 0. | 0. | -6. |
| 17.093 | .843 | 24831. | 37863. | 0. | 0. | -6. |
| 17.098 | .848 | 24974. | 38075. | 0. | 0. | -6. |
| 17.103 | .853 | 25117. | 38287. | 0. | 0. | -6. |
| 17.108 | .858 | 25260. | 38499. | 0. | 0. | -6. |
| 17.113 | .863 | 25403. | 38711. | 0. | 0. | -6. |
| 17.118 | .868 | 25546. | 38923. | 0. | 0. | -6. |
| 17.123 | .873 | 25689. | 39135. | 0. | 0. | -6. |
| 17.128 | .878 | 25832. | 39347. | 0. | 0. | -6. |
| 17.133 | .883 | 25975. | 39559. | 0. | 0. | -6. |
| 17.138 | .888 | 26118. | 39771. | 0. | 0. | -6. |
| 17.143 | .893 | 26261. | 39983. | 0. | 0. | -6. |
| 17.148 | .898 | 26404. | 40195. | 0. | 0. | -6. |
| 17.153 | .903 | 26547. | 40407. | 0. | 0. | -6. |
| 17.158 | .908 | 26690. | 40619. | 0. | 0. | -6. |
| 17.163 | .913 | 26833. | 40831. | 0. | 0. | -6. |
| 17.168 | .918 | 26976. | 41043. | 0. | 0. | -6. |
| 17.173 | .923 | 27119. | 41255. | 0. | 0. | -6. |
| 17.178 | .928 | 27262. | 41467. | 0. | 0. | -6. |
| 17.183 | .933 | 27405. | 41679. | 0. | 0. | -6. |
| 17.188 | .938 | 27548. | 418911.</ | | | |

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR No 1
 BY WJV DATE 2-6-79 PROJ. NO. 79-617-214
 KD. BY _____ DATE _____ SHEET NO. X OF _____

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 Environmental Specialists



BEGIN DAM FAILURE AT 16.25 HOURS
 DRAIN OUTFLOW IN FEET AT TIME IN HOURS

(5)

SUBJECT

DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR No 1

BY WJV

DATE

2-6-79

PROJ. NO.

79-617-214

CHKD. BY

DATE

SHEET NO.

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THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .021 HOURS DURING BREACH FORMATION.
DOWNSTREAM CALCULATIONS WILL USE A 11% INTERVAL OF .043 HOURS.
THIS TABLE COMPARES THE HYDROGRAPH FOR DOWNSTREAM CALCULATIONS WITH THE COMPUTED BREACH HYDROGRAPH.
INTERMEDIATE FLOODS ARE INTERPOLATED FROM END-OF-PERIOD VALUES.

| TIME (HOURS) | TIME FROM BEGINNING OF BREACH (HOURS) | INTERPOLATED BREACH HYDROGRAPH (CFS) | COMPUTED BREACH HYDROGRAPH (CFS) | ERROR (CFS) | ACCUMULATED ERROR (CFS) | ACCUMULATED ERROR (AC-F1) |
|-----------------|--|---|---|----------------|-------------------------------|---------------------------------|
| 16.250 | 0.000 | 663. | 663. | 0. | 0. | 0. |
| 16.271 | .021 | 766. | 754. | 33. | 33. | 0. |
| 16.292 | .042 | 910. | 873. | 37. | 70. | 0. |
| 16.313 | .063 | 1034. | 1020. | 13. | 83. | 0. |
| 16.333 | .083 | 1157. | 1157. | 0. | 83. | 0. |
| 16.354 | .104 | 1275. | 1296. | -21. | 62. | 0. |
| 16.375 | .125 | 1393. | 1420. | -27. | 35. | 0. |
| 16.396 | .146 | 1511. | 1532. | -21. | 13. | 0. |
| 16.417 | .167 | 1532. | 1524. | 8. | 13. | 0. |
| 16.438 | .188 | 1530. | 1524. | 6. | 13. | 0. |
| 16.458 | .208 | 1532. | 1532. | 0. | 13. | 0. |
| 16.479 | .229 | 1514. | 1524. | -10. | 3. | 0. |
| 16.500 | .250 | 1475. | 1475. | 0. | 3. | 0. |
| 16.521 | .271 | 1429. | 1466. | -37. | -34. | 0. |
| 16.542 | .292 | 1383. | 1418. | -35. | -69. | 0. |
| 16.563 | .313 | 1337. | 1398. | -61. | -130. | 0. |
| 16.583 | .333 | 1291. | 1361. | -70. | -200. | 0. |
| 16.604 | .354 | 1243. | 1290. | -47. | -247. | 0. |
| 16.625 | .375 | 1194. | 1242. | -48. | -295. | 0. |
| 16.646 | .396 | 1146. | 1192. | -46. | -341. | 0. |
| 16.667 | .417 | 1097. | 1147. | -50. | -391. | 0. |
| 16.688 | .437 | 1000. | 1000. | 0. | -391. | 0. |
| 16.708 | .458 | 1302. | 1303. | -1. | -392. | 0. |
| 16.729 | .479 | 1305. | 1305. | 0. | -392. | 0. |
| 16.750 | .500 | 1308. | 1308. | 0. | -392. | 0. |
| 16.771 | .521 | 1310. | 1310. | 0. | -392. | 0. |
| 16.792 | .542 | 1311. | 1312. | -1. | -393. | 0. |
| 16.813 | .563 | 1313. | 1314. | -1. | -394. | 0. |
| 16.833 | .583 | 1315. | 1315. | 0. | -394. | 0. |
| 16.854 | .604 | 1316. | 1316. | 0. | -394. | 0. |
| 16.875 | .625 | 1316. | 1317. | -1. | -395. | 0. |
| 16.896 | .646 | 1317. | 1317. | 0. | -395. | 0. |
| 16.917 | .667 | 1318. | 1318. | 0. | -395. | 0. |
| 16.938 | .687 | 1317. | 1318. | -1. | -396. | 0. |
| 16.958 | .708 | 1317. | 1317. | 0. | -396. | 0. |
| 16.979 | .729 | 1316. | 1317. | -1. | -397. | 0. |
| 17.000 | .750 | 1316. | 1316. | 0. | -397. | 0. |
| 17.021 | .771 | 1315. | 1315. | 0. | -397. | 0. |
| 17.042 | .792 | 1313. | 1314. | -1. | -398. | 0. |
| 17.063 | .812 | 1312. | 1312. | 0. | -398. | 0. |
| 17.083 | .833 | 1310. | 1310. | 0. | -398. | 0. |
| 17.104 | .854 | 1308. | 1308. | 0. | -398. | 0. |
| 17.125 | .875 | 1306. | 1306. | 0. | -398. | 0. |
| 17.146 | .896 | 1304. | 1304. | 0. | -398. | 0. |
| 17.167 | .917 | 1302. | 1302. | 0. | -398. | 0. |
| 17.188 | .937 | 1300. | 1300. | 0. | -398. | 0. |
| 17.208 | .958 | 1297. | 1297. | 0. | -398. | 0. |
| 17.229 | .979 | 1295. | 1295. | 0. | -398. | 0. |
| 17.250 | 1.000 | 1292. | 1292. | 0. | -398. | 0. |

5

SUBJECT

DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR No 1

BY WJV

DATE

2-6-79

PROJ. NO.

73-617-214

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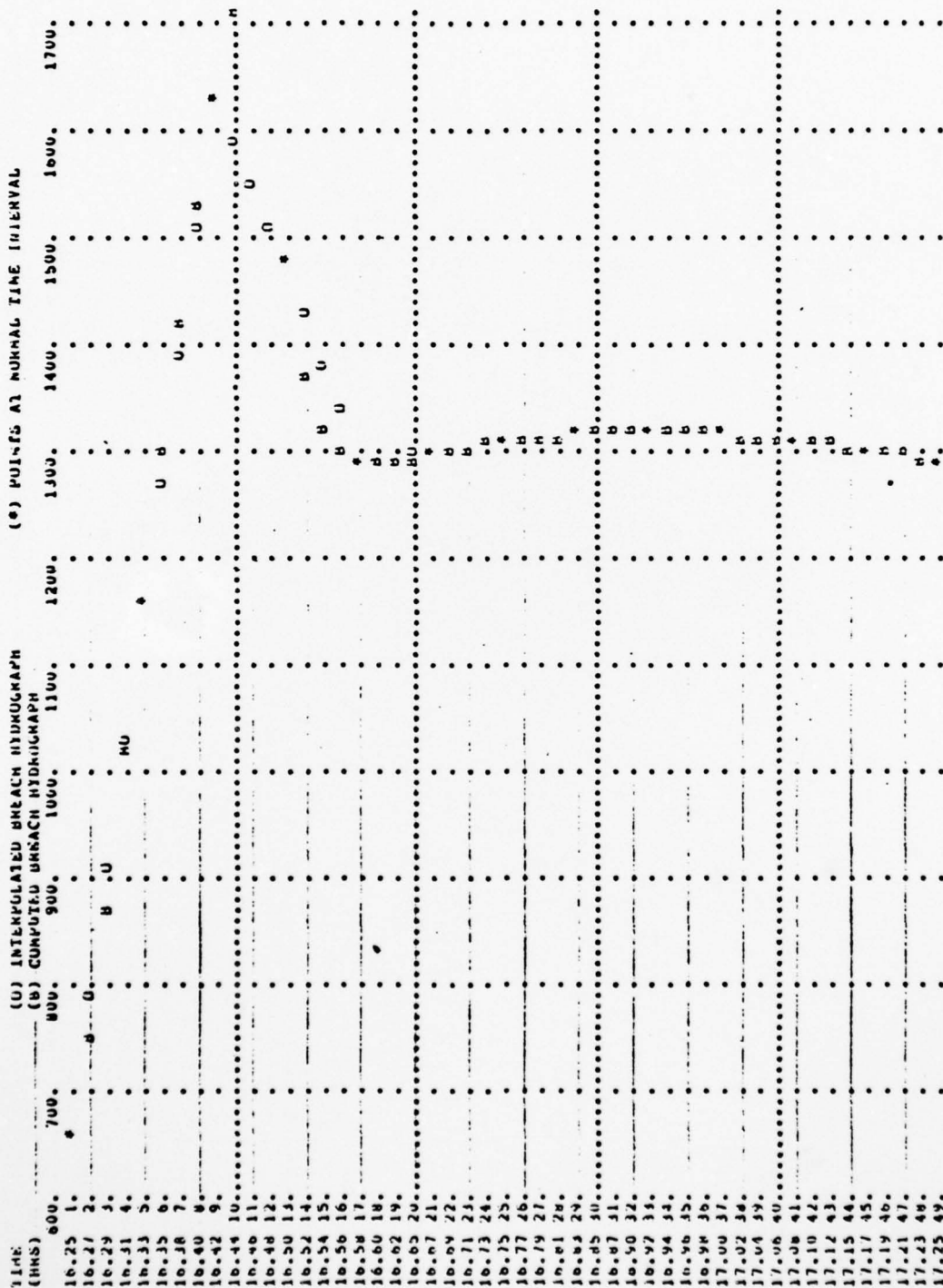
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5

SUBJECT

DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR No 1

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Environmental SpecialistsRESERVOIR
No 3

| SUMMARY OF DAM SAFETY ANALYSIS | | | | | | | | | |
|--------------------------------|-----------------------------------|------------------------------|-----------------------------|---------------------------|-------------------------------|---------------------------------|-----------------------------|-------------------------|-----------------------------|
| PLAN | MAXIMUM RESERVOIR W.S. ELEV | MAXIMUM DEPTH OVER DAM | MAXIMUM STORAGE AC-FT | MAXIMUM OUTFLOW CFS | DURATION OVER TOP HOURS | TIME OF MAX OUTFLOW HOURS | TIME OF FAILURE HOURS | TOP OF DAM ELEVATION | SPILLWAY CREST ELEVATION |
| 1 | 1433.34 | .24 | 395. | 19572. | .19 | 18.50 | 18.25 | 1433.10 | 1430.50 |
| 2 | 1433.19 | .09 | 392. | 29691. | .10 | 18.37 | 18.25 | 390. | 340. |
| 3 | 1433.64 | .54 | 401. | 3136. | 1.17 | 20.42 | 16.25 | 816. | 126. |
| 4 | 1433.35 | .25 | 395. | 4330. | .25 | 18.75 | 18.25 | | |
| 5 | 1433.31 | .21 | 395. | 5997. | .21 | 18.03 | 18.25 | | |
| 6 | 1433.63 | .53 | 601. | 5996. | .46 | 18.83 | 18.50 | | |
| SUMMARY OF DAM SAFETY ANALYSIS | | | | | | | | | |
| | 1345.80 | | 1345.80 | 1347.60 | | | | | |
| | 121. | | 121. | 130. | | | | | |
| | 0. | | 0. | 378. | | | | | |

RESERVOIR
No 2

| SUMMARY OF DAM SAFETY ANALYSIS | | | | | | | | | |
|--------------------------------|-----------------------------------|------------------------------|-----------------------------|---------------------------|-------------------------------|---------------------------------|-----------------------------|-------------------------|-----------------------------|
| PLAN | MAXIMUM RESERVOIR W.S. ELEV | MAXIMUM DEPTH OVER DAM | MAXIMUM STORAGE AC-FT | MAXIMUM OUTFLOW CFS | DURATION OVER TOP HOURS | TIME OF MAX OUTFLOW HOURS | TIME OF FAILURE HOURS | TOP OF DAM ELEVATION | SPILLWAY CREST ELEVATION |
| 1 | 1347.89 | .29 | 139. | 15532. | .19 | 18.58 | 18.17 | 1347.60 | 1294.30 |
| 2 | 1347.79 | .19 | 138. | 32481. | .10 | 18.37 | 18.17 | 56. | 45. |
| 3 | 1348.59 | .99 | 147. | 3762. | 2.00 | 20.42 | 18.17 | 622. | |
| 4 | 1348.03 | .43 | 140. | 5255. | .50 | 18.75 | 18.17 | | |
| 5 | 1348.25 | .05 | 143. | 7734. | .54 | 18.75 | 18.17 | | |
| 6 | 1348.30 | .70 | 143. | 7597. | .56 | 18.92 | 18.13 | | |
| SUMMARY OF DAM SAFETY ANALYSIS | | | | | | | | | |
| | 1291.80 | | 1291.80 | 1291.80 | | | | | |
| | 45. | | 45. | 45. | | | | | |
| | 0. | | 0. | 622. | | | | | |

RESERVOIR
No 1

| SUMMARY OF DAM SAFETY ANALYSIS | | | | | | | | | |
|--------------------------------|-----------------------------------|------------------------------|-----------------------------|---------------------------|-------------------------------|---------------------------------|-----------------------------|-------------------------|-----------------------------|
| PLAN | MAXIMUM RESERVOIR W.S. ELEV | MAXIMUM DEPTH OVER DAM | MAXIMUM STORAGE AC-FT | MAXIMUM OUTFLOW CFS | DURATION OVER TOP HOURS | TIME OF MAX OUTFLOW HOURS | TIME OF FAILURE HOURS | TOP OF DAM ELEVATION | SPILLWAY CREST ELEVATION |
| 1 | 1297.26 | 2.96 | 70. | 15715. | .48 | 18.58 | 16.25 | 1294.30 | 1294.30 |
| 2 | 1294.34 | .04 | 56. | 33969. | .09 | 18.42 | 16.25 | 56. | 45. |
| 3 | 1294.44 | .14 | 56. | 3927. | 1.00 | 20.56 | 16.25 | 622. | |
| 4 | 1294.34 | .04 | 56. | 5740. | .17 | 18.75 | 16.25 | | |
| 5 | 1294.34 | .04 | 56. | 8115. | .10 | 18.75 | 16.25 | | |
| 6 | 1295.27 | .97 | 60. | 8479. | 2.52 | 18.90 | 18.42 | | |
| SUMMARY OF DAM SAFETY ANALYSIS | | | | | | | | | |
| | 1291.80 | | 1291.80 | 1291.80 | | | | | |
| | 45. | | 45. | 45. | | | | | |
| | 0. | | 0. | 622. | | | | | |

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR No 1
 BY WIV DATE 2-6-79 PROJ. NO. 78-617-214
 CHKD. BY _____ DATE _____ SHEET NO. BB OF _____



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DOWNSTREAM CHANNEL ROUTING FROM RESERVOIR #1 TO SECTION 7

SUMMARY

| PLAN | RATIO | MAXIMUM FLOW, CFS | MAXIMUM STAGE, FT | TIME HOURS |
|------|-------|----------------------|----------------------|---------------|
| 1 | .50 | 15883. | 1266.0 | 18.58 |
| 2 | .50 | 34609. | 1271.6 | 18.42 |
| 3 | .50 | 3936. | 1259.4 | 20.50 |
| 4 | .50 | 5750. | 1260.8 | 18.83 |
| 5 | .50 | 8112. | 1262.3 | 18.75 |
| 6 | .50 | 8415. | 1262.5 | 18.92 |

DOWNSTREAM CHANNEL ROUTING FROM SECTION 7 TO SECTION 8

SUMMARY

| PLAN | RATIO | MAXIMUM FLOW, CFS | MAXIMUM STAGE, FT | TIME HOURS |
|------|-------|----------------------|----------------------|---------------|
| 1 | .50 | 16406. | 1220.9 | 18.58 |
| 2 | .50 | 34624. | 1225.6 | 18.42 |
| 3 | .50 | 3930. | 1214.7 | 20.50 |
| 4 | .50 | 5762. | 1216.0 | 18.83 |
| 5 | .50 | 8040. | 1217.5 | 18.75 |
| 6 | .50 | 8325. | 1217.7 | 18.92 |

LIST OF REFERENCES

1. "Recommended Guidelines for Safety Inspection of Dams," prepared by Department of the Army Office of the Chief of Engineers, Washington, D. C. (Appendix D).
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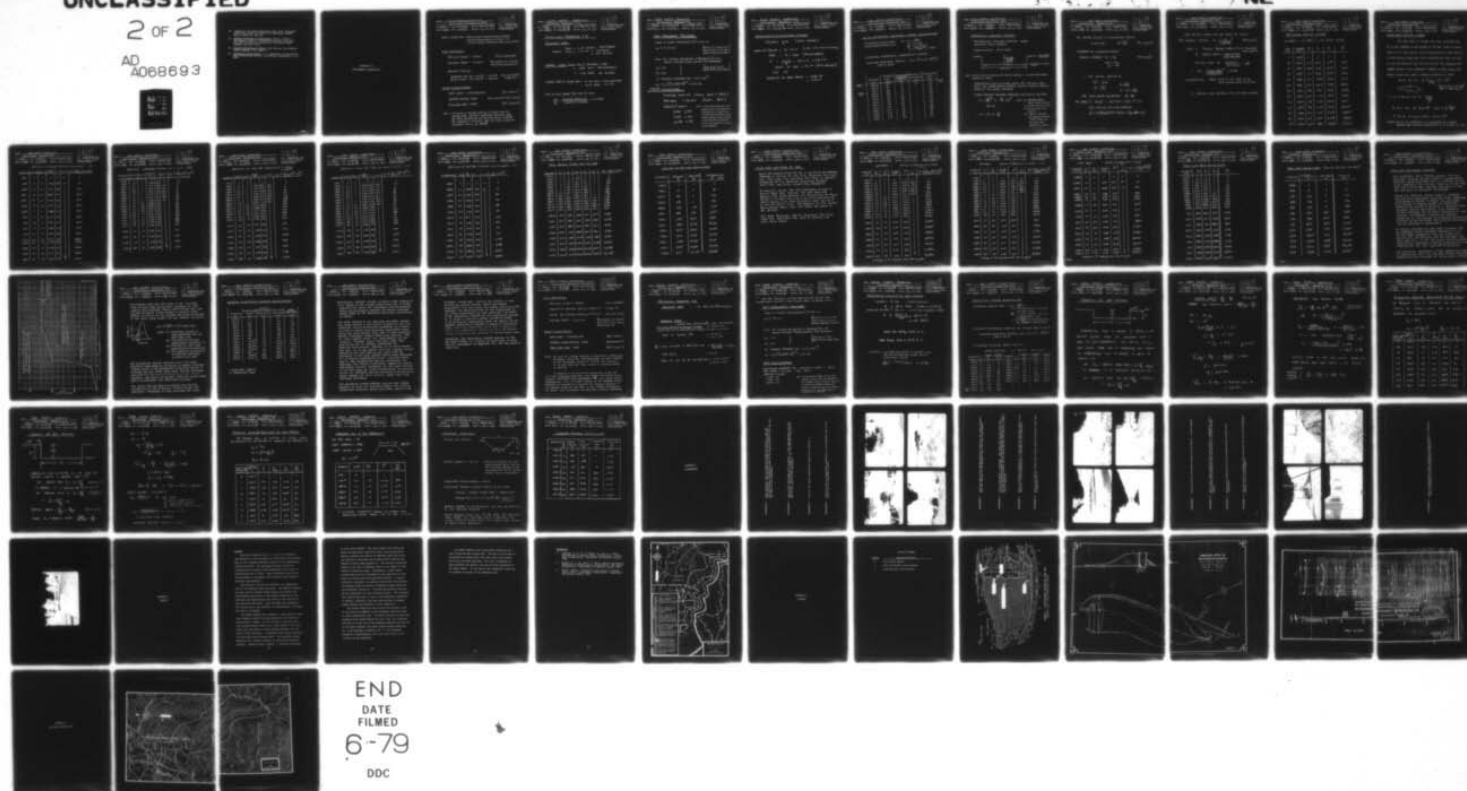
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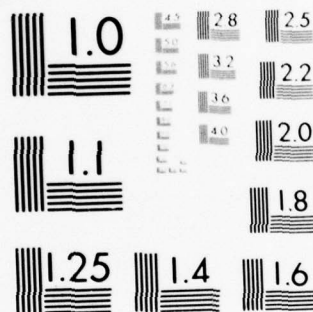
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APPENDIX C-1
SUPPLEMENTAL CALCULATIONS

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR N°2
BY DLB DATE 10-27-78 PROJ. NO. 78-617-215
CHKD. BY WJV DATE 1/9/79 SHEET NO. 1 OF 29



DAM LOCATION - BROWNFIELD QUADRANGLE, FAYETTE
COUNTY, PENNSYLVANIA; U.S.G.S. 7.5
MINUTE SERIES, (TOPOGRAPHIC) PHOTO REVISED 1973

DAM STATISTICS

MAXIMUM HEIGHT - 47 FEET (FIELD MEASURED)

DRAINAGE AREA - 2.0 SP. MI. (PLANIMETERED OFF U.S.G.S.
BROWNFIELD QUADRANGLE)

STORAGE CAPACITY -

@ NORMAL POOL (EL 1345.8) - 121 AC-FT (SEE NOTE BELOW)
@ TOP OF DAM (EL 1347.6) - 136 AC-FT (SHEET 5)

SIZE CLASSIFICATION

DAM SIZE - INTERMEDIATE (REF 1; TABLE 1)

HAZARD RATING - HIGH (FIELD OBSERVATION; REF 1; TABLE 2)

REQUIRED SDF - PMF (REF 1; TABLE 3)

NOTE: THE VALUE OF STORAGE CAPACITY IS TAKEN FROM AN
UNPUBLISHED NOTEBOOK CONTAINING PERTINANT DATA
FOR DAMS OPERATED BY THE UNIONTOWN BRANCH OF W.P.W.
THE NOTEBOOK IS AVAILABLE FROM THE FILES LOCATED AT
UNIONTOWN OFFICE OF W.P.W.

SUBJECT DAM SAFETY INSPECTION.

HUTCHINSON RESERVOIR # 2.

BY KHK DATE 10-12-78 PROJ. NO. 78-617-215

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HUTCHINSON RESERVOIR # 2.

DRAINAGE AREA:

LOCAL = 0.09 SQ. MILE (PLANIMETERED).

OVERALL TOTAL = 1.9 + 0.09 = 1.99 SQ. MILES
≈ 2.0 SQ. MILES.

SURFACE AREA (NORMAL POOL) ELEV 1345.8 ≈ 1346
= .087 SQ. IN. (PLANIMETERED).
= 7.99 ACRES USE 8 ACRES.

SURFACE AREA AT. CONTOUR 1360 = 0.143 SQ. IN. (PLANIMETERED)
= 13.13 ACRES. USE 13.1

RATE OF AREA CHANGE PER FOOT OF RISE:

$$\frac{\Delta A}{\Delta y} = \frac{(13.1 \text{ ACRES}) - (8.0 \text{ ACRES})}{(1360 \text{ FEET}) - (1346 \text{ FEET})} = 0.36 \text{ ACRE/FT}$$

SUBJECT

DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR # 2

BY

KHK

DATE

10-24-78

PROJ. NO.

78-617-215

CHKD. BY

REV

DATE

10-25-78

SHEET NO.

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OF

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[VALUES OF L AND LCA ARE
FROM U.S.G.S. 7.5 MINUTE
SERIES QUAD BROWNFIELD, PA.]

NOTE: ALL VARIABLES ARE DEFINED IN REFERENCE 2 IN THE
SECTION ENTITLED "SNYDER SYNTHETIC UNIT HYDROGRAPH".

 $C_t = 1.6$ $C_p = 0.5$

[SUPPLIED BY COF E;
ZONE 29, OHIO RIVER BASIN]

 $t_p = \text{SNYDER'S STANDARD LAG} = 1.6(L \times LCA)^{0.3}$ $t_p = (1.6)[(0.51)(0.17)]^{0.3} = 0.77 \text{ HRS}$ PMP CALCULATIONS

HUTCHINSON DAM # 2 LOCATION ZONE 7 (REF 3)

PMP INDEX = 24 INCHES (FIGURE 1, REF 3)

DURATION % INDEX:-

6 HRS = 102

12 HRS = 120

24 HRS = 130

NOTE: A 24-HOUR DURATION RATHER THAN A 48-HOUR

DURATION WAS USED. THIS WAS NECESSITATED
BY THE NEED TO USE A 5-MINUTE TIME
STEP IN THE HEC-5-DAM PROGRAM IN ORDER
TO MORE ACCURATELY DEFINE THE PEAKS
OF THE HYDROGRAPHS. (A MAXIMUM OF
ONLY 300 TIME INTERVALS IS ALLOWED
IN THE PROGRAM.)

SUBJECT

DAM SAFETY INSPECTIONHUTCHINSON RESERVOIR # 2

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29Engineers • Geologists • Planners
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$$\text{VOLUME} = \frac{1}{3} HA \quad (\text{CONIC METHOD})$$

$$\text{NORMAL POOL VOLUME} = 121 \text{ AC-FT} \quad (\text{WPW. FILES UNION TOWN OFFICE})$$

$$\text{AREA} = 8.0 \text{ ACRES} \quad (\text{PLANIMETERED}).$$

$$H = \frac{3 \times 121}{8} = 45.4 \text{ FT} \approx 45.4 \text{ FT.}$$

$$\text{HEIGHT OF DAM} = 47 \text{ FT.} \quad (\text{FIELD MEASURED})$$

USE 47.

$$\begin{aligned} \text{ELEVATION OF ZERO VOLUME} &= 1346 - 47 \\ &= 1299 \text{ FT.} \end{aligned}$$

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ACTUAL ESTIMATED ELEVATION-STORAGE RELATIONSHIP

ESTIMATED SURFACE AREA : $A = A_0 + \left(\frac{\Delta A}{\Delta Y}\right)Y$
 (LINEAR INTERPOLATION EQUATION)
 $A_0 = 8.0$ ACRES
 $\frac{\Delta A}{\Delta Y} = 0.36$ ACRES/FOOT
 $Y = (\text{ELEVATION OF CONCERN}) - 1345.9'$

ESTIMATED INCREMENTAL INCREASE IN STORAGE :

MODIFIED PRISMOIDAL FORMULA : $\Delta V_{1-2} = \frac{Y}{3} (A_1 + A_2 + \sqrt{A_1 \cdot A_2})$
 (REF 14, PG 15)

| | ELEVATION (FT) | ESTIMATED AREA (ACRE) | CUMULATIVE INCREASE IN STORAGE ABOVE NORMAL POOL VIA MOD. PRIS. EQ (A-F) | AVAILABLE STOR. BELOW NORMAL POOL (A-F) | ACTUAL ESTIMATED STORAGE (A-F) | |
|---------------|-------------------|-----------------------------|--|---|--------------------------------------|----------------|
| NORMAL POOL - | 1345.9 | 8.0 | 0 | 121 | 121 | KNOWN VALUE |
| | 1346.0 | 8.1 | 2 | " | 123 | |
| | 1347.0 | 8.4 | 10 | " | 131 | |
| TOP OF DAM - | 1347.6 | 8.6 | 15 | " | 136 | |
| | 1348.0 | 8.8 | 19 | " | 140 | |
| | 1349.0 | 9.2 | 28 | " | 149 | |
| | 1350.0 | 9.5 | 37 | " | 153 | |
| | 1351.0 | 9.9 | 47 | " | 169 | |
| | 1352.0 | 10.2 | 57 | " | 179 | |
| | 1353.0 | 10.6 | 67 | " | 189 | |
| | 1354.0 | 11.0 | 79 | " | 199 | |
| | 1355.0 | 11.3 | 89 | " | 210 | |
| | 1356.0 | 11.7 | 100 | " | 221 | |

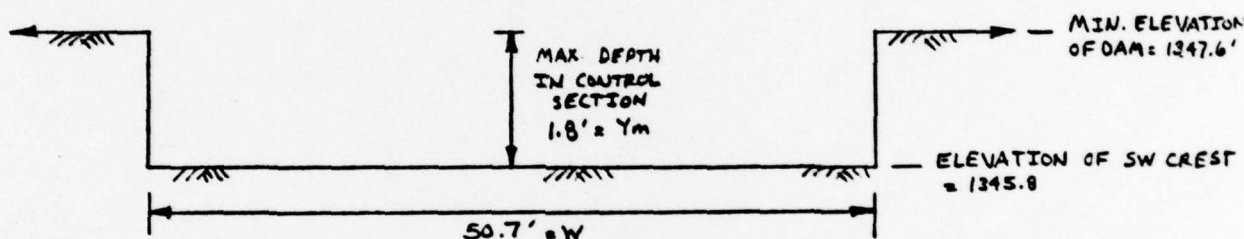
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EMERGENCY SPILLWAY CAPACITY

RECTANGULAR SPILLWAY SECTION WITH CRITICAL FLOW CONTROL

CONTROL SECTION : (NOT TO SCALE)



NOTE: SPILLWAY ELEVATION OBTAINED FROM FIGURE 3, APPENDIX F. ALL OTHER MEASUREMENTS OBTAINED IN FIELD

SUPERCritical FLOW IS ASSUMED BELOW THE SPILLWAY CREST WITH THE WATER SURFACE PROFILE PASSING THROUGH CRITICAL DEPTH AT THE CONTROL SECTION.

ENERGY BALANCE BETWEEN RESERVOIR AND CONTROL SECTION:

$$Y_m + \frac{v_r^2}{2g} = Y_c + \frac{v_c^2}{2g} + H_L$$

(REF 13)

WHERE: v_r = RESERVOIR APPROACH VELOCITY (ASSUMED NEGLECTIBLE)
 Y_c = CRITICAL CONTROL SECT. DEPTH
 v_c = CRITICAL CONTROL SECT. VELOCITY
 H_L = HEAD LOSS BETWEEN THE RESERVOIR ENTRANCE TO THE SPILLWAY AND THE CONTROL SECT. (ASSUMED NEGLECTIBLE)

$$\therefore Y_m = 1.8' = Y_c + \frac{v_c^2}{2g}$$

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THE CRITICAL VELOCITY IN A RECTANGULAR SECTION

IS GIVEN BY : $V_c = \sqrt{gy_c}$ (REF 13, Pg 141)

FURTHERMORE FOR A RECTANGULAR CHANNEL :

SPECIFIC ENERGY = $Y_m = 1.5y_c$ (REF 13, Pg 143)

$$1.8 \text{ FT} = 1.5y_c$$

$$y_c = 1.2 \text{ FT}$$

∴ THE CRITICAL VELOCITY IS:

$$V_c^2 = y_c(g)$$

$$V_c = \sqrt{y_c g}$$

$$V_c = \sqrt{(1.2)g}$$

$$V_c = 6.22 \text{ ft/sec}$$

THE FLOW CAN BE CALCULATED : $Q_c = V A_c$

THE AREA IS: $W(y_c) = 50.7'(1.2) = 60.84 \text{ FT}^2 = A_c$

Q_c = MAXIMUM SPILLWAY CAPACITY

$$Q_c = (6.22)(60.84) \approx 378 \text{ cfs (say 380 cfs)}$$

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THE CRITICAL SLOPE CAN BE FOUND BY USE OF
 THE MANNING FORMULA: $S_c = \left(\frac{n Q}{1.49 A_c R_c^{2/3}} \right)^2$ (REF 13, pg 143)

Where n = MANNING'S Roughness coefficient (0.014 FOR CONCRETE)
 (REF 13, pg 133)

R_c = HYDRAULIC RADIUS = $\frac{\text{AREA OF FLOW}}{\text{WETTED PERIMETER}}$

FOR THIS CASE $R_c = \frac{(50.7)(1.2)}{50.7 + 2(1.2)} = \underline{\underline{1.15}}$

$$\therefore S_c = \left(\frac{0.014 (378)}{1.49 (60.84) (1.15)^{2/3}} \right)^2 = 0.0028$$

$0.0028 < 0.03$ where 0.03 is THE SLOPE OF THE
 CHUTE CHANNEL BELOW THE SPILLWAY

\therefore CRITICAL FLOW CONTROLS THE SPILLWAY DISCHARGE

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Environmental SpecialistsSPILLWAY RATING CURVE

$$y_c = \text{HEAD}/1.5 ; V_c = (g)(y_c)^{1/2} ; A_c = 50.7 y_c ; Q = A_c V_c$$

| HEAD (FT) | ELEVATION (FT) | y_c | V_c | A_c | Q |
|--------------|-------------------|-------|-------|--------|---------|
| 0 | 1345.8 | 0 | 0 | 0 | 0 |
| 0.2 | 1346.0 | 0.13 | 2.05 | 6.59 | 13.5 |
| 1.2 | 1347.0 | 0.80 | 5.08 | 40.56 | 206.0 |
| 1.8 | 1347.6 | 1.20 | 6.22 | 60.84 | 378.4 |
| 2.2 | 1348.0 | 1.47 | 6.88 | 74.53 | 512.8 |
| 3.2 | 1349.0 | 2.13 | 8.28 | 107.99 | 894.2 |
| 4.2 | 1350.0 | 2.80 | 9.50 | 141.96 | 1,348.6 |
| 5.2 | 1351.0 | 3.47 | 10.57 | 175.93 | 1,859.6 |
| 6.2 | 1352.0 | 4.13 | 11.53 | 209.39 | 2,414.3 |
| 7.2 | 1353.0 | 4.80 | 12.43 | 243.36 | 3,025.0 |
| 8.2 | 1354.0 | 5.47 | 13.27 | 277.33 | 3,680.2 |
| 9.2 | 1355.0 | 6.13 | 14.05 | 310.79 | 4,366.6 |
| 10.2 | 1356.0 | 6.80 | 14.80 | 344.76 | 5,102.4 |

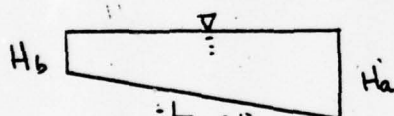
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MAIN DAM RATING CURVE

THE MAIN DAM IS DIVIDED INTO FIVE SEGMENTS DUE TO SLIGHT CHANGES IN THE HEIGHT OF THE DAM ALONG ITS LENGTH. SECTION 1 IS FROM STATION 0+00 TO 0+60; SECTION 2 FROM STA 1+10 TO 1+60; SECTION 3 FROM STA 1+60 TO 4+60; SECTION 4 FROM STA 4+60 TO 5+10; AND SECTION 5 FROM STA 5+10 TO 5+60. FOR OVERTOPPING, TAKE AVERAGE HEIGHT ON THE OVERTOPPED PORTION OF EACH SECTION. OVERTOPPING OCCURS WHEN WATER SURFACE ELEVATION IS 1347.6

FOR ALL SECTIONS $Q_i = \frac{2}{3} \frac{C_i L_i}{H_a - H_b} (H_a^{5/2} - H_b^{5/2})$



(Derived form of $Q = CLH^{3/2}$,
 REF. 14 - Chapter A-5 p. 3)

C_i can be determined FROM $H_i = \frac{H_a + H_b}{2}$

IF $H_b = 0$ then $Q_i = \frac{2}{3} CL H_a^{3/2}$ where $C = f\left(\frac{H_a}{2L}\right)$

IF $H_a = H_b$ use original formula $Q_i = C_i L_i H_i^{3/2}$

NOTE: ASSUME THE EMBANKMENT WILL DISCHARGE AS A BROAD CRESTED WEIR DURING OVERTOPPING WITH A BREADTH OF 12 FT.

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SECTION 1 of MAIN DAM (STATIONS 0+00 to 0+60) L=60'

| ELEVATION | H _A (FT) | H _B (FT) | $\frac{H_A + H_B}{2}$ | C | L (FT) | $Q_1 = \frac{7}{8} \frac{C L}{H_A - H_B} (H_A^{5/2} - H_B^{5/2})$ |
|-----------|---------------------|---------------------|-----------------------|------|--------|---|
| 1348.7 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1348.8 | 0.1 | 0 | 0.004 | 2.90 | 60 | 5.5 |
| 1349.0 | 0.3 | 0.2 | 0.021 | 2.99 | | 22.5 |
| 1349.2 | 0.5 | 0.4 | 0.038 | 3.01 | | 54.6 |
| 1349.4 | 0.7 | 0.6 | 0.054 | 3.02 | | 95.0 |
| 1349.6 | 0.9 | 0.8 | 0.071 | 3.03 | | 142.5 |
| 1349.8 | 1.1 | 1.0 | 0.088 | 3.03 | | 195.7 |
| 1350.0 | 1.3 | 1.2 | 0.104 | 3.04 | | 255.0 |
| 1350.5 | 1.8 | 1.7 | 0.146 | 3.05 | | 423.7 |
| 1351.0 | 2.3 | 2.2 | 0.188 | 3.07 | | 621.7 |
| 1351.5 | 2.8 | 2.7 | 0.229 | 3.08 | | 842.8 |
| 1352.0 | 3.3 | 3.2 | 0.271 | 3.09 | | 1086.3 |
| 1353.0 | 4.3 | 4.2 | 0.354 | 3.09 | | 1624.4 |
| 1354.0 | 5.3 | 5.2 | 0.438 | 3.09 | | 2230.3 |
| 1355.0 | 6.3 | 6.2 | 0.521 | 3.09 | | 2896.9 |
| 1356.0 | 7.3 | 7.2 | 0.604 | 3.09 | ✓ | 3619.3 |

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SECTION 2 OF MAIN DAM (STATIONS 1+10 to 1+60) $L=50'$

| ELEVATION | H_A (FT) | H_B (FT) | $\frac{H_A + H_B}{2L}$ | C | L (FT) | $Q_2 = \frac{CL}{H_A - H_B} (H_A^{5/2} - H_B^{5/2})$ |
|-----------|------------|------------|------------------------|------|----------|--|
| 1347.6 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1347.8 | 0.2 | 0 | 0.008 | 2.94 | 7.1 | 0.7 |
| 1348.0 | 0.4 | 0 | 0.017 | 2.96 | 14.3 | 4 |
| 1348.2 | 0.6 | 0 | 0.025 | 2.98 | 21.4 | 12 |
| 1348.4 | 0.8 | 0 | 0.033 | 3.00 | 28.6 | 25 |
| 1348.6 | 1.0 | 0 | 0.042 | 3.01 | 35.7 | 43 |
| 1348.8 | 1.2 | 0 | 0.050 | 3.02 | 42.9 | 68 |
| 1349.0 | 1.4 | 0 | 0.058 | 3.02 | 50 | 100 |
| 1349.2 | 1.6 | 0.2 | 0.075 | 3.03 | ↓ | 139 |
| 1349.4 | 1.8 | 0.4 | 0.092 | 3.04 | | 184 |
| 1349.6 | 2.0 | 0.6 | 0.108 | 3.04 | | 234 |
| 1349.8 | 2.2 | 0.8 | 0.125 | 3.04 | | 287 |
| 1350.0 | 2.4 | 1.0 | 0.142 | 3.05 | | 345 |
| 1350.5 | 2.9 | 1.5 | 0.183 | 3.08 | | 509 |
| 1351.0 | 3.4 | 2.0 | 0.225 | 3.08 | | 689 |
| 1351.5 | 3.9 | 2.5 | 0.267 | 3.09 | | 890 |
| 1352.0 | 4.4 | 3.0 | 0.308 | 3.09 | | 1105 |
| 1353.0 | 5.4 | 4.0 | 0.392 | 3.09 | | 1579 |
| 1354.0 | 6.4 | 5.0 | 0.475 | 3.09 | | 2107 |
| 1355.0 | 7.4 | 6.0 | 0.558 | 3.09 | | 2683 |
| 1356.0 | 8.4 | 7.0 | 0.642 | 3.09 | ↓ | 3305 |

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SECTION 3 OF MAIN DAM (STATIONS 1+60 to 4+60)
 L = 300 FT

| ELEVATION | H _A (FT) | H _B (FT) | $\frac{H_A + H_B}{2}$ | C | L(FT) | $Q_3 = \frac{2}{5} \frac{CL}{H_A - H_B} (H_A^{5/2} - H_B^{5/2})$ |
|-----------|---------------------|---------------------|-----------------------|------|-------|--|
| 1347.7 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1347.8 | 0.1 | 0 | 0.004 | 2.90 | 23.1 | 1 |
| 1348.0 | 0.3 | 0 | 0.013 | 2.94 | 69.2 | 13. |
| 1348.2 | 0.5 | 0 | 0.021 | 2.96 | 115.4 | 48. |
| 1348.4 | 0.7 | 0 | 0.029 | 2.99 | 161.5 | 113. |
| 1348.6 | 0.9 | 0 | 0.038 | 3.01 | 207.7 | 214 |
| 1348.8 | 1.1 | 0 | 0.046 | 3.02 | 253.8 | 354 |
| 1349.0 | 1.3 | 0 | 0.054 | 3.02 | 300.0 | 537. |
| 1349.2 | 1.5 | 0.2 | 0.071 | 3.03 | | 766 |
| 1349.4 | 1.7 | 0.4 | 0.088 | 3.03 | | 1026 |
| 1349.6 | 1.9 | 0.6 | 0.104 | 3.04 | | 1318. |
| 1349.8 | 2.1 | 0.8 | 0.121 | 3.04 | | 1633 |
| 1350.0 | 2.3 | 1.0 | 0.138 | 3.04 | | 1971 |
| 1350.5 | 2.8 | 1.5 | 0.179 | 3.06 | | 2927. |
| 1351.0 | 3.3 | 2.0 | 0.221 | 3.08 | | 4016. |
| 1351.5 | 3.8 | 2.5 | 0.263 | 3.09 | | 5210 |
| 1352.0 | 4.3 | 3.0 | 0.304 | 3.09 | | 6490 |
| 1353.0 | 5.3 | 4.0 | 0.388 | 3.09 | | 9318 |
| 1354.0 | 6.3 | 5.0 | 0.471 | 3.09 | | 12470. |
| 1355.0 | 7.3 | 6.0 | 0.554 | 3.09 | | 15,916 |
| 1356.0 | 8.3 | 7.0 | 0.638 | 3.09 | ✓ | 19,632. |

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SECTION 4 OF MAIN DAM (STATIONS 4+60 TO 5+10) L=50'

| ELEVATION | H _A (FT) | H _B (FT) | $\frac{H_A + H_B}{2}$ | C | L(FT) | $Q_4 = \frac{2}{5} \frac{CL}{H_A - H_B} (H_A^{5/2} - H_B^{5/2})$ |
|-----------|---------------------|---------------------|-----------------------|------|-------|--|
| 1347.7 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1347.8 | 0.1 | 0 | 0.004 | 2.90 | 3.6 | 0 |
| 1348.0 | 0.3 | 0 | 0.013 | 2.94 | 10.7 | 2. |
| 1348.2 | 0.5 | 0 | 0.021 | 2.96 | 17.9 | 8 |
| 1348.4 | 0.7 | 0 | 0.029 | 2.99 | 25.0 | 18 |
| 1348.6 | 0.9 | 0 | 0.038 | 3.01 | 32.1 | 33. |
| 1348.8 | 1.1 | 0 | 0.046 | 3.02 | 39.3 | 55 |
| 1349.0 | 1.3 | 0 | 0.054 | 3.02 | 46.4 | 83. |
| 1349.2 | 1.5 | 0.1 | 0.067 | 3.03 | 50.0 | 119. |
| 1349.4 | 1.7 | 0.3 | 0.083 | 3.03 | | 161. |
| 1349.6 | 1.9 | 0.5 | 0.100 | 3.04 | | 208. |
| 1349.8 | 2.1 | 0.7 | 0.117 | 3.04 | | 260 |
| 1350.0 | 2.3 | 0.9 | 0.133 | 3.04 | | 315. |
| 1350.5 | 2.8 | 1.4 | 0.175 | 3.06 | | 472. |
| 1351.0 | 3.3 | 1.9 | 0.217 | 3.08 | | 652 |
| 1351.5 | 3.8 | 2.4 | 0.258 | 3.09 | | 849 |
| 1352.0 | 4.3 | 2.9 | 0.300 | 3.09 | | 1,060. |
| 1353.0 | 5.3 | 3.9 | 0.383 | 3.09 | | 1,529 |
| 1354.0 | 6.3 | 4.9 | 0.467 | 3.09 | | 2,051. |
| 1355.0 | 7.3 | 5.9 | 0.550 | 3.09 | | 2,623 |
| 1356.0 | 8.3 | 6.9 | 0.633 | 3.09 | | 3,241 |

SUBJECT DAM SAFETY INSPECTIONHUTCHINSON RESERVOIR #2BY RFV DATE 10-18-78 PROJ. NO. 78-617-215CHKD. BY KWW DATE 10-24-78 SHEET NO. 15 OF 29Engineers • Geologists • Planners
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SECTIONS OF MAIN DAM (STATIONS 5+10 to 5+60) L=50'

| ELEVATION | H (ft) | H/L | C | L (ft) | $Q_s = C L H^{3/2}$ |
|-----------|--------|-------|------|--------|---------------------|
| 1349.1 | 0 | 0 | 0 | 0 | 0 |
| 1349.2 | 0.1 | 0.008 | 2.94 | 50 | 5 |
| 1349.4 | 0.3 | 0.025 | 2.98 | | 25 |
| 1349.6 | 0.5 | 0.042 | 3.01 | | 53. |
| 1349.8 | 0.7 | 0.058 | 3.02 | | 88. |
| 1350.0 | 0.9 | 0.075 | 3.03 | | 129. |
| 1350.5 | 1.4 | 0.117 | 3.04 | | 252. |
| 1351.0 | 1.9 | 0.158 | 3.05 | | 399. |
| 1351.5 | 2.4 | 0.200 | 3.07 | | 571 |
| 1352.0 | 2.9 | 0.242 | 3.08 | | 761 |
| 1353.0 | 3.9 | 0.325 | 3.09 | | 1,190 |
| 1354.0 | 4.9 | 0.408 | 3.09 | | 1,676 |
| 1355.0 | 5.9 | 0.492 | 3.09 | | 2,214. |
| 1356.0 | 6.9 | 0.575 | 3.09 | | 2,800. |

SUBJECT

DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR #2

BY

RFV

DATE

10-18-78

PROJ. NO.

78-617-215

CHKD. BY

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DATE

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TOTAL RATING CURVE FOR MAIN DAM

| ELEVATION | Q ₁ | Q ₂ | Q ₃ | Q ₄ | Q ₅ | Q _T = $\sum_{i=1}^5 Q_i$ (CFS) |
|-----------|----------------|----------------|----------------|----------------|----------------|---|
| 1347.6 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1347.8 | 0 | 0.7 | 0.8 | 0.1 | 0 | 2 |
| 1348.0 | 0 | 4.3 | 13.4 | 2.1 | 0 | 20 |
| 1348.2 | 0 | 11.9 | 48.3 | 7.5 | 0 | 68 |
| 1348.4 | 0 | 24.6 | 113.1 | 17.5 | 0 | 155 |
| 1348.6 | 0 | 43.0 | 213.5 | 33.0 | 0 | 290 |
| 1348.8 | 5.5 | 68.1 | 353.7 | 54.8 | 0 | 482 |
| 1349.0 | 22.5 | 100.1 | 537.2 | 83.1 | 0 | 743 |
| 1349.2 | 54.6 | 139.4 | 765.7 | 119.1 | 4.6 | 1,083 |
| 1349.4 | 95.0 | 184.4 | 1,025.6 | 161.0 | 24.5 | 1,490 |
| 1349.6 | 142.5 | 233.6 | 1,318.1 | 208.4 | 53.2 | 1,956 |
| 1349.8 | 195.7 | 286.9 | 1,632.7 | 259.7 | 88.4 | 2,463 |
| 1350.0 | 255.0 | 345.2 | 1,970.7 | 315.0 | 129.4 | 3,015 |
| 1350.5 | 423.7 | 508.9 | 2,927.2 | 472.1 | 251.8 | 4,584 |
| 1351.0 | 621.7 | 689.0 | 4,016.1 | 651.5 | 399.4 | 6,378 |
| 1351.5 | 842.8 | 889.7 | 5,210.2 | 848.7 | 570.7 | 8,362 |
| 1352.0 | 1,086.3 | 1,104.5 | 6,489.9 | 1,060.3 | 760.5 | 10,502 |
| 1353.0 | 1,624.4 | 1,578.5 | 9,317.9 | 1,528.7 | 1,189.9 | 15,239 |
| 1354.0 | 2,230.3 | 2,106.5 | 12,470.1 | 2,051.4 | 1,675.8 | 20,534 |
| 1355.0 | 2,896.9 | 2,683.1 | 15,915.9 | 2,623.3 | 2,214.1 | 26,333 |
| 1356.0 | 3,619.3 | 3,304.6 | 19,632.0 | 3,240.5 | 2,800.3 | 32,597 |

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR # 2
BY REV DATE 10-18-78 PROJ. NO. 78-617-215
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SPILLWAY AND MAIN DAM RATING CURVE

| ELEVATION | SPILLWAY Q_s | MAIN DAM Q_d | COMBINED FLOW Q_T (CFS) |
|-----------|-------------------|-------------------|------------------------------|
| 1345.8 | 0 | 0 | 0 |
| 1346.0 | 14 | 0 | 14 |
| 1347.0 | 206 | 0 | 206 |
| 1347.6 | 378 | 0 | 378 |
| 1348.0 | 513 | 20 | 533 |
| 1349.0 | 894 | 743 | 1,637 |
| 1350.0 | 1,349 | 3,015 | 4,364 |
| 1351.0 | 1860 | 6,378 | 8,238 |
| 1352.0 | 2,414 | 10,502 | 12,916 |
| 1353.0 | 3,025 | 15,239 | 18,264 |
| 1354.0 | 3680 | 20,534 | 24,214 |
| 1355.0 | 4,367 | 26,333 | 30,700 |
| 1356.0 | 5,102 | 32,597 | 37,699 |

SUBJECT DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR No 2

B. RFV DATE 10/20/79 PROJ. NO. 79-617-215

CHKD. BY WJV DATE 1/2/79 SHEET NO. 18 OF 29



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FLOW OVER LEFT BANK OF DAM

DUE TO THE LOCATION OF DAM #2 AND A LOW SPOT IN THE SURROUNDING TERRAIN, A PORTION OF THE TOTAL RESERVOIR DISCHARGE WILL FLOW OVER THE LEFT BANK AND INTO AN ADJACENT WATERSHED IF THE RESERVOIR ELEVATION EXCEEDS 1347.7 FEET (SEE REGIONAL VICINITY MAP, APPENDIX G)

IN ORDER TO ACCOUNT FOR THIS ADDITIONAL OUTLET, A RATING TABLE WAS COMPUTED. THE LEFT BANK WAS DIVIDED INTO THREE SECTIONS FOR CALCULATION OF FLOWS. SECTION 1 IS FROM STA 0+00 TO STA 2+10 (SEE SKETCH MAP, APPEN. F). SECTION 2 IS FROM STA 2+10 TO 2+60. SECTION 3 IS FROM STA 2+60 TO 3+60. THE BREADTH OF THE ASSUMED BROAD CRESTED WEIR-LIKE LEFT BANK WAS TAKEN TO BE 50 FEET.

THE SAME PROCEDURE USED IN COMPUTING THE FLOWS OVER THE MAIN DAM WAS USED TO COMPUTE THE LEFT BANK FLOWS.

SUBJECT DAM SAFETY INSPECTIONHUTCHINSON RESERVOIR #2BY RFV DATE 10-18-78 PROJ. NO. 78-617-215CHKD. BY Klu DATE 10-24-78 SHEET NO. 19 OF 29


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L = 210'

| ELEVATION (FT) | H _A (FT) | H _B (FT) | $\frac{H_A + H_B}{2}$ | C* | L (FT) | $Q_1 = \frac{2}{5} \frac{CL}{H_A - H_B} \left(H_A^{\frac{5}{2}} - H_B^{\frac{5}{2}} \right)$ |
|-------------------|------------------------|------------------------|-----------------------|------|-----------|---|
| 1347.7 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1347.8 | 0.1 | 0 | 0.001 | 2.90 | 23.3 | 0.9 |
| 1348.0 | 0.3 | 0 | 0.003 | 2.94 | 70.0 | 13.5 |
| 1348.2 | 0.5 | 0 | 0.005 | 2.96 | 116.7 | 48.9 |
| 1348.4 | 0.7 | 0 | 0.007 | 2.99 | 163.3 | 115.1 |
| 1348.6 | 0.9 | 0 | 0.009 | 3.01 | 210.0 | 215.9 |
| 1348.8 | 1.1 | 0.2 | 0.013 | 3.02 | | 352.7 |
| 1349.0 | 1.3 | 0.4 | 0.017 | 3.03 | | 516.3 |
| 1349.2 | 1.5 | 0.6 | 0.021 | 3.03 | | 700.4 |
| 1349.4 | 1.7 | 0.8 | 0.025 | 3.04 | | 906.7 |
| 1349.6 | 1.9 | 1.0 | 0.029 | 3.04 | | 1,128.1 |
| 1349.8 | 2.1 | 1.2 | 0.033 | 3.04 | | 1,365.7 |
| 1350.0 | 2.3 | 1.4 | 0.037 | 3.04 | | 1,618.3 |
| 1350.5 | 2.8 | 1.9 | 0.047 | 3.05 | | 2,318.0 |
| 1351.0 | 3.3 | 2.4 | 0.057 | 3.05 | | 3,089.2 |
| 1351.5 | 3.8 | 2.9 | 0.067 | 3.05 | | 3,886.7 |
| 1352.0 | 4.3 | 3.4 | 0.077 | 3.05 | | 4,846.7 |
| 1353.0 | 5.3 | 4.4 | 0.097 | 3.05 | | 6,843.6 |
| 1354.0 | 6.3 | 5.4 | 0.117 | 3.05 | | 9,069.3 |
| 1355.0 | 7.3 | 6.4 | 0.137 | 3.05 | | 11,489.2 |
| 1356.0 | 8.3 | 7.4 | 0.157 | 3.05 | | 14,093.0 |

* VALUES OF "C" OBTAINED FROM REF. 12, P 46

SUBJECT

DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR #2

BY

RFV

DATE

10-18-78

PROJ. NO.

78-617-215

CHKD. BY

VUU

DATE

10-24-78

SHEET NO.

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OF

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LEFT BANK :

SECTION 2 (STATION 2+10 to 2+60) L=50'

| ELEVATION (FT) | H _A (FT) | H _B (FT) | $\frac{H_A + H_B}{2}$ | C* | L (FT) | $Q_2 = \frac{2}{3} \frac{C L}{H_A H_B} \left(H_A^{\frac{5}{2}} - H_B^{\frac{5}{2}} \right)$ |
|-------------------|------------------------|------------------------|-----------------------|------|-----------|--|
| 1347.7 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1347.8 | 0.1 | 0 | 0.001 | 2.90 | 5.6 | 0.2 |
| 1348.0 | 0.3 | 0 | 0.003 | 2.94 | 16.7 | 3.2 |
| 1348.2 | 0.5 | 0 | 0.005 | 2.96 | 27.8 | 11.6 |
| 1348.4 | 0.7 | 0 | 0.007 | 2.99 | 38.9 | 27.4 |
| 1348.6 | 0.9 | 0 | 0.009 | 3.01 | 50.0 | 51.4 |
| 1348.8 | 1.1 | 0.2 | 0.013 | 3.02 | | 84.0 |
| 1349.0 | 1.3 | 0.4 | 0.017 | 3.03 | | 122.9 |
| 1349.2 | 1.5 | 0.6 | 0.021 | 3.03 | | 166.8 |
| 1349.4 | 1.7 | 0.8 | 0.025 | 3.04 | | 215.9 |
| 1349.6 | 1.9 | 1.0 | 0.029 | 3.04 | | 268.6 |
| 1349.8 | 2.1 | 1.2 | 0.033 | 3.04 | | 325.2 |
| 1350.0 | 2.3 | 1.4 | 0.037 | 3.04 | | 385.3 |
| 1350.5 | 2.8 | 1.9 | 0.047 | 3.05 | | 551.9 |
| 1351.0 | 3.3 | 2.4 | 0.057 | 3.05 | | 736.1 |
| 1351.5 | 3.8 | 2.9 | 0.067 | 3.05 | | 937.2 |
| 1352.0 | 4.3 | 3.4 | 0.077 | 3.05 | | 1,154.0 |
| 1353.0 | 5.3 | 4.4 | 0.097 | 3.05 | | 1,630.6 |
| 1354.0 | 6.3 | 5.4 | 0.117 | 3.05 | | 2,159.4 |
| 1355.0 | 7.3 | 6.4 | 0.137 | 3.05 | | 2,735.5 |
| 1356.0 | 8.3 | 7.4 | 0.157 | 3.05 | ↓ | 3,355.5 |

* VALUES OF "C" OBTAINED FROM REF 12, PG 46

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR # 2
 BY RFV DATE 10-18-78 PROJ. NO. 78-617-215
 CHKD. BY KMM DATE 10-24-78 SHEET NO. 21 OF 29

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LEFT BANK : SECTION 3 (STATION 2+60 to 3+60)
 L = 100'

| ELEVATION (FT) | H _A (FT) | H _B (FT) | $\frac{H_A + H_B}{2}$ | C* | L (FT) | $Q_3 = \frac{2}{5} \frac{CL}{H_A - H_B} \left(H_A^{\frac{5}{2}} - H_B^{\frac{5}{2}} \right)$ |
|-------------------|------------------------|------------------------|-----------------------|------|-----------|---|
| 1348.6 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1348.8 | 0.2 | 0 | 0.002 | 2.94 | 50 | 5.3 |
| 1349.0 | 0.4 | 0 | 0.004 | 2.96 | 100 | 30.0 |
| 1349.2 | 0.6 | 0.2 | 0.008 | 3.00 | | 78.3 |
| 1349.4 | 0.8 | 0.4 | 0.012 | 3.02 | | 142.3 |
| 1349.6 | 1.0 | 0.6 | 0.016 | 3.03 | | 218.5 |
| 1349.8 | 1.2 | 0.8 | 0.020 | 3.03 | | 304.5 |
| 1350.0 | 1.4 | 1.0 | 0.024 | 3.04 | | 401.0 |
| 1350.5 | 1.9 | 1.5 | 0.034 | 3.04 | | 675.0 |
| 1351.0 | 2.4 | 2.0 | 0.044 | 3.05 | | 996.3 |
| 1351.5 | 2.9 | 2.5 | 0.054 | 3.05 | | 1,354.1 |
| 1352.0 | 3.4 | 3.0 | 0.064 | 3.05 | | 1,746.8 |
| 1353.0 | 4.4 | 4.0 | 0.084 | 3.05 | | 2,626.1 |
| 1354.0 | 5.4 | 5.0 | 0.104 | 3.05 | | 3,617.3 |
| 1355.0 | 6.4 | 6.0 | 0.124 | 3.05 | | 4,709.1 |
| 1356.0 | 7.4 | 7.0 | 0.144 | 3.05 | | 5,893.0 |

* VALUES OF "C" OBTAINED FROM REF 12, PG 46

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR #2
 BY RFV DATE 10-18-78 PROJ. NO. 78-617-215
 CHKD. BY KWK DATE 10-24-78 SHEET NO. 22 OF 29



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TOTAL LEFT BANK RATING CURVE

| ELEVATION (FT) | Q ₁ | Q ₂ | Q ₃ | Q _T |
|-------------------|----------------|----------------|----------------|----------------|
| 1347.7 | 0 | 0 | 0 | 0 |
| 1347.8 | 0.9 | 0.2 | 0 | 1 |
| 1348.0 | 13.5 | 3.2 | 0 | 17 |
| 1348.2 | 48.9 | 11.6 | 0 | 61 |
| 1348.4 | 115.1 | 27.4 | 0 | 143 |
| 1348.6 | 215.9 | 51.4 | 0 | 267 |
| 1348.8 | 352.7 | 84.0 | 5.3 | 442 |
| 1349.0 | 516.3 | 122.9 | 30.0 | 669 |
| 1349.2 | 700.4 | 166.8 | 78.3 | 946 |
| 1349.4 | 906.7 | 215.9 | 142.3 | 1265 |
| 1349.6 | 1,128.1 | 268.6 | 218.5 | 1615 |
| 1349.8 | 1,365.7 | 325.2 | 304.5 | 1995 |
| 1350.0 | 1,618.3 | 385.3 | 401.0 | 2405 |
| 1350.5 | 2,318.0 | 551.9 | 675.0 | 3545 |
| 1351.0 | 3,089.2 | 736.1 | 996.3 | 4822 |
| 1351.5 | 3,886.7 | 937.2 | 1,354.1 | 6178 |
| 1352.0 | 4,846.7 | 1,154.0 | 1,746.8 | 7748 |
| 1353.0 | 6,843.6 | 1,630.6 | 2,626.1 | 11,100 |
| 1354.0 | 9,069.3 | 2,159.4 | 3,617.3 | 14,846 |
| 1355.0 | 11,489.2 | 2,735.5 | 4,709.1 | 18,934 |
| 1356.0 | 14,093.0 | 3,355.5 | 5,893.0 | 23,342 |

SUBJECT DAM SAFETY INSPECTIONHUTCHINSON RESERVOIR # 2BY RFV DATE 10-24-78 PROJ. NO. 78-617-215CHKD. BY KMM DATE 10-24-78 SHEET NO. 23 OF 29Engineers • Geologists • Planners
Environmental SpecialistsTOTAL DAM RATING CURVE (SPILLWAY + MAIN DAM + LEFT BANK)

| ELEVATION | MAIN DAM + SPILLWAY Q | LEFT BANK Q | TOTAL Q CFS |
|-----------|-----------------------------|----------------|----------------|
| 1345.8 | 0 | 0 | 0 |
| 1346 | 14 | 0 | 14 |
| 1347 | 206 | 0 | 206 |
| 1347.6 | 378 | 0 | 378 |
| 1348 | 533 | 17 | 550 |
| 1349 | 1,637 | 669 | 2,306 |
| 1350 | 4,364 | 2,405 | 6,769 |
| 1351 | 8,237 | 4,822 | 13,059 |
| 1352 | 12,916 | 7,748 | 20,664 |
| 1353 | 18,264 | 11,100 | 29,364 |
| 1354 | 24,214 | 14,846 | 39,060 |
| 1355 | 30,700 | 18,934 | 49,634 |
| 1356 | 37,699 | 23,342 | 61,041 |

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR N° 2
BY WJV DATE 1/2/79 PROJ. NO. 79-617-215
CHKD. BY DLB DATE 1/9/79 SHEET NO. 24 OF 29



LEFT BANK DISCHARGE PROBLEM

THE MODIFIED HEC-I PROGRAM ASSUMES THAT ALL RESERVOIR OUTFLOW PROCEEDS DIRECTLY DOWNSTREAM. HOWEVER, ABOVE ELEVATION 1347.7 A PORTION OF THE TOTAL RESERVOIR #2 OUTFLOW (ABOUT $\frac{1}{3}$ OF THE PEAK PMF FLOW) DISCHARGES OVER THE LEFT BANK OF THE DAM AND INTO AN ADJACENT WATERSHED.

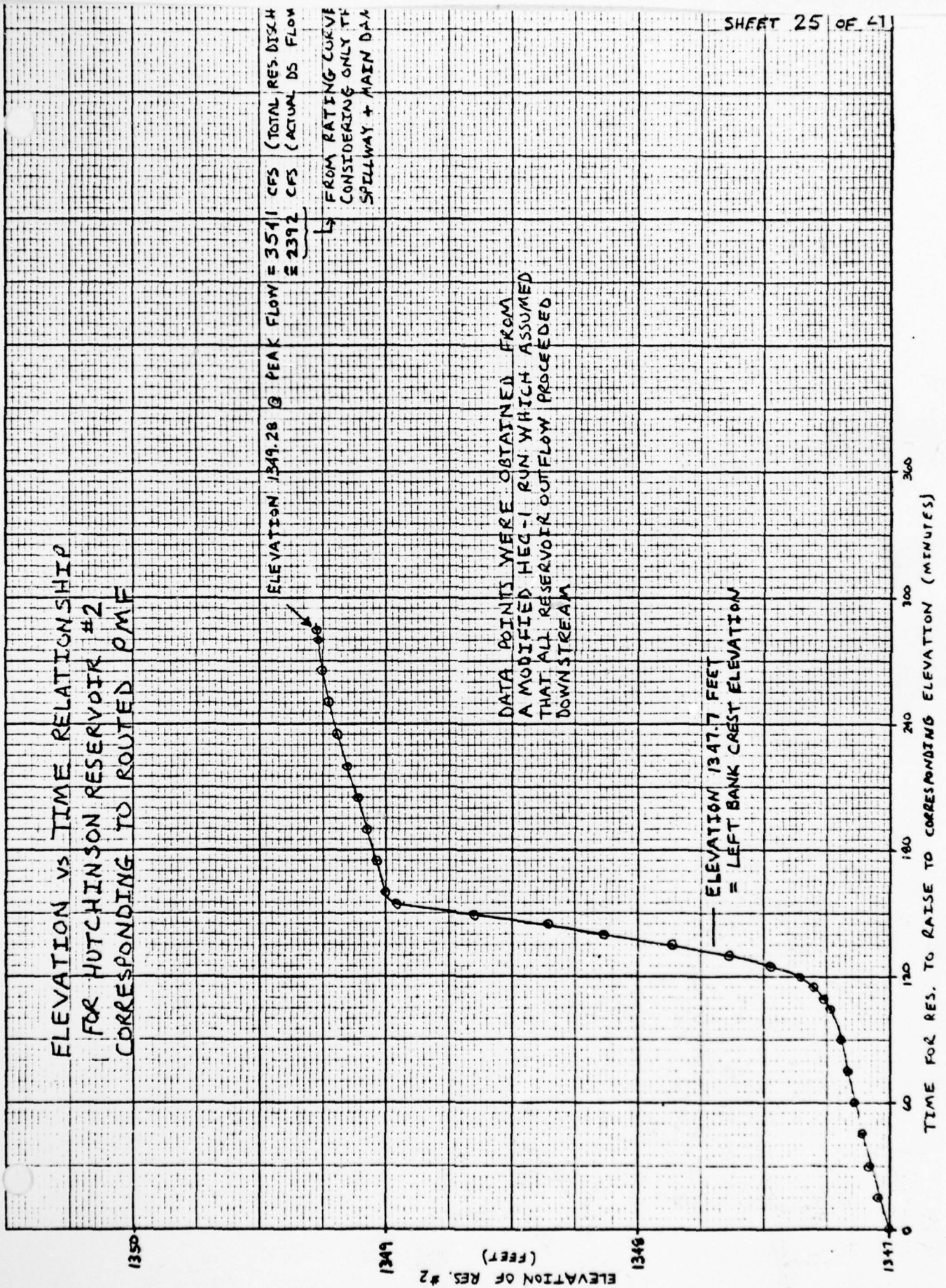
SINCE THE PROGRAM CANNOT DIRECTLY SEPERATE THE LEFT BANK DISCHARGES FROM THE TOTAL RESERVOIR DISCHARGES, A SCHEME TO CONVERT THE LEFT BANK FLOW VALUES TO STORAGE VALUES WAS DEVELOPED. (MODIFIED PULS ROUTING IS BASICALLY A PROCEDURE WHICH BALANCES INFLOWS AND OUTFLOWS WITH AVAILABLE STORAGE. THEREFORE, IF THE INFLOW HYDROGRAPH IS HELD CONSTANT, THE RESERVOIR OUTFLOWS ARE DIRECTLY CONTROLLED BY THE STORAGE \Rightarrow TO DECREASE OR ELIMINATE A PORTION OF THE DISCHARGE, THE CORRESPONDING STORAGE MUST BE INCREASED TO COMPENSATE.)

AN INITIAL COMPUTER RUN WAS MADE ASSUMING THAT ALL RESERVOIR OUTFLOW PROCEEDED DOWNSTREAM (ie, A RATING TABLE CONSIDERING TOTAL DISCHARGE FROM THE SPILLWAY, THE MAIN DAM, AND THE LEFT BANK WAS USED; SHEET 23), SO THAT THE ACTUAL RESERVOIR SURFACE FLUCTUATIONS (ELEVATION vs TIME RELATIONSHIP) RESULTING FROM ROUTING THE PMF COULD BE ESTABLISHED.

THE RESERVOIR ELEVATION vs TIME INFORMATION (SHEET 25) IN CONJUNCTION WITH THE LEFT BANK RATING TABLE (SHEET 22) ENABLED INITIAL ESTIMATES OF THE VOLUMES OF WATER

ELEVATION VS TIME RELATIONSHIP FOR HUTCHINSON RESERVOIR #2 CORRESPONDING TO ROUTED PMF

SHEET 25 OF 41

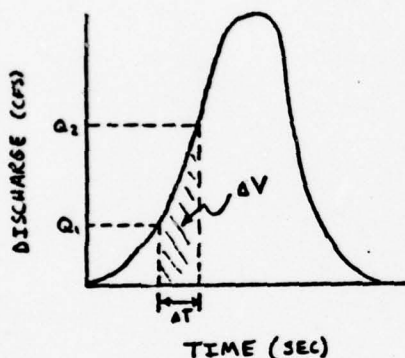


SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR NO 2
 WJV DATE 1/3/79 PROJ. NO. 79-617-215
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DISCHARGING OVER THE LEFT BANK TO BE COMPUTED. THESE VOLUMES WERE CALCULATED ACCORDING TO THE LOGICAL RELATIONSHIP BELOW, WHICH STATES THAT THE VOLUME OF WATER PASSED DURING A CERTAIN TIME PERIOD IS EQUAL TO THE AVERAGE DISCHARGE MULTIPLIED BY THE TOTAL TIME LENGTH OF THAT PERIOD (SEE SKETCH):



$$\Delta V = \left[\left(\frac{Q_1 + Q_2}{2} \right) \times \Delta T \right] / 43560 \text{ FT}^2/\text{ACRE}$$

WHERE ΔV = INCREMENTAL VOLUME OF WATER DISCHARGED OVER THE LEFT BANK (A-F),
 Q_1 = FLOW OVER THE LEFT BANK CORRESPONDING TO ELEVATION 1 (CFS)
 Q_2 = FLOW OVER THE LEFT BANK CORRESPONDING TO ELEVATION 2 (CFS)
 ΔT = TIME NECESSARY FOR RESERVOIR TO RAISE FROM ELEVATION 1 TO ELEVATION 2 (SEC).

THE VOLUMES OF WATER COMPUTED WITH THE ABOVE EQUATION WERE ADDED TO THE ACTUAL ESTIMATED AVAILABLE STORAGE VALUES AT THE APPROPRIATE ELEVATIONS (SHEET 27). A COMPUTER RUN WAS MADE USING THESE INITIAL ARTIFICIAL STORAGE VALUES (ACTUAL + INITIAL ON SHEET 27) TO REPLACE THE LEFT BANK DISCHARGE POTENTIAL, AND USING THE SPILLWAY + MAIN DAM RATING TABLE (SHEET 17) TO DETERMINE THE RESERVOIR OUTFLOWS.

THE OUTPUT FROM THE ABOVE RUN SHOWED THAT FURTHER CALIBRATION OF THE ARTIFICIAL STORAGE VALUES WAS NECESSARY. THEREFORE, BY TRIAL AND ERROR THE FINAL

SUBJECT DAM SAFETY INSPECTIONHUTCHINSON RESERVOIR NO 2WJV DATE 1/4/79 PROJ. NO. 78-617-215CHKD. BY DLB DATE 2-6-79 SHEET NO. 27 OF 29Engineers • Geologists • Planners
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| ELEVATION (FT) | ACTUAL ESTIMATED STORAGE * (A-F) | CUMULATIVE | ACTUAL + INITIAL STORAGE VALUES (A-F) | FINAL ARTIFICIAL STORAGE VALUES (A-F) |
|-------------------|--|---|---|--|
| | | INITIAL ARTIFICIAL STORAGE VALUES (A-F) | | |
| 1299.0 | 0 | 0 | 0 | 0 |
| 1345.8 | 121 | 0 | 121 | 121 |
| 1346.0 | 123 | 0 | 123 | 123 |
| 1347.0 | 131 | 0 | 131 | 131 |
| 1347.6 | 136 | 0 | 136 | 136 |
| 1347.7 | 137 | 0 | 137 | 137 |
| 1347.8 | 138 | 0 | 138 | 138 |
| 1348.0 | 140 | 0.1 | 140.1 | 140.1 |
| 1349.2 | 141.8** | 0.4 | 142.2 | 142.2 |
| 1349.4 | 143.6** | 0.9 | 144.5 | 144.5 |
| 1349.6 | 145.4** | 1.9 | 147.3 | 147.3 |
| 1349.8 | 147.2** | 3.7 | 150.9 | 150.9 |
| 1349.0 | 149 | 9.9 | 158.9 | 158.9 |
| 1349.2 | 150.8** | 99.8 | 249.6 | 300.0 |
| 1349.3 | 151.7** | 183.6 | 335.3 | 500.0 |

* VALUES FROM SHEET 5

** INTERPOLATED VALUE

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR No 2
BY WJV DATE 1/3/79 PROJ. NO. 78-617-215
CHKD. BY DLB DATE 1/9/79 SHEET NO. 28 OF 29



ARTIFICIAL STORAGE VALUES ON SHEET 27 WERE ARRIVED AT. (THE PURPOSE OF THE FURTHER CALIBRATION WAS TO BETTER REPRODUCE THE KNOWN PMF DOWNSTREAM OUTFLOW HYDROGRAPH WHICH WAS OBTAINED BY APPLYING THE SPILLWAY + MAIN DAM RATING TABLE TO THE RESERVOIR ELEVATION INFORMATION ON SHEET 25).

THE ABOVE APPROACH TO THE LEFT BANK DISCHARGE PROBLEM WAS CHOSEN INSTEAD OF JUST SIMPLY MULTIPLYING THE TOTAL RESERVOIR OUTFLOW HYDROGRAPH ORDINATES BY A RATIO (ie, 0.67) TO OBTAIN MORE REALISTIC DOWNSTREAM FLOWS, SINCE THE RATIO METHOD WOULD LEAD TO MORE ERRONEOUS RESULTS, ESPECIALLY DURING BREACHING ANALYSIS. THAT IS, ONCE A BREACH OCCURS, THE WATER BEHIND THE DAM QUICKLY RECEDES BELOW THE LEFT BANK CREST ELEVATION, AND ALL OUTFLOW THEREAFTER IS DIRECTED DOWNSTREAM. HOWEVER, IF THE RATIO METHOD WAS USED ALL OF THE BREACH OUTFLOWS, WHETHER ACTUALLY AFFECTED BY THE LEFT BANK OR NOT, WOULD FIRST BE MULTIPLIED BY THE RATIO BEFORE INFLOW INTO RESERVOIR No 1 OR FURTHER DOWNSTREAM TRAVEL. THIS THEN WOULD LEAD TO VERY CONSERVATIVE RESULTS DOWNSTREAM. IN ADDITION, THE OUTFLOW HYDROGRAPHS GENERATED DURING OVERTOPPING ANALYSIS (ESPECIALLY FOR THE LOWER FRACTIONS OF THE PMF) WOULD BE QUITE CONSERVATIVE VOLUME-WISE, BECAUSE ALL ORDINATES WOULD BE MULTIPLIED BY THE ONE RATIO VALUE, WHEREAS THE RATIO ACTUALLY VARIES WITH THE RESERVOIR ELEVATION.

THE ARTIFICIAL STORAGE APPROACH ALSO HAS SOME MINOR DRAWBACKS IN THAT THE RECESSTION LIMBS OF THE OUTFLOW HYDROGRAPHS GENERATED DURING OVERTOPPING ANALYSIS ARE

SUBJECT

DAM SAFETY INSPECTIONHUTCHINSON RESERVOIR NO 2

B.

WJV

DATE

1/3/79

PROJ. NO.

78-617-215

CHKD. BY

DLB

DATE

1/9/79

SHEET NO.

29

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INCORRECT SINCE THEY CONTAIN THE EFFECTS OF THE ARTIFICIAL STORAGE VOLUMES BEING DISCHARGED DOWNSTREAM (THE FLOW VALUES ARE LARGER THAN SHOULD BE). HOWEVER, THE RECESSION LIMB OF THE HYDROGRAPH IS OF LITTLE IMPORTANCE IN THIS ANALYSIS. THE EFFECT OF THE ARTIFICIAL STORAGE ON THE BREACHING ANALYSIS IS TO CAUSE A SLIGHTLY LARGER VOLUME OF WATER TO BE DISCHARGED DOWNSTREAM ONCE THE BREACH OCCURS. HOWEVER, BREACHING IS ASSUMED TO BEGIN AT ELEVATION 1347.6 (TOP OF DAM ELEVATION), OR AT MOST AT ELEVATION 1348.1 (1/2 FT ABOVE DAM) AT WHICH ELEVATIONS THE INCREASED STORAGE VOLUMES WHICH WILL BE ROUTED DS ARE NEGLIGIBLE (SHEET 27)

THEREFORE, THE ARTIFICIAL STORAGE APPROACH TO THE LEFT BANK PROBLEM IS THOUGHT TO GIVE MORE ACCURATE RESULTS DOWNSTREAM OF RESERVOIR NO 2 FOR THIS PHASE I ANALYSIS

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR DAM N^o 3
BY DLB DATE 8-28-78 PROJ. NO. 78-617-216
CHRG. BY EJM DATE 9-13-78 SHEET NO. 1 OF 15



DAM STATISTICS

MAXIMUM HEIGHT \approx 56 FEET (FIELD MEASURED)

MAXIMUM POOL STORAGE CAPACITY \approx 390 AC-FT (SHEET 5)

NORMAL POOL STORAGE CAPACITY \approx 340 AC-FT (SEE NOTE BELOW)

DRAINAGE AREA \approx 1.9 SQ. MILES

[PLANIMETERED OFF U.S.G.S.
7.5 MINUTE SERIES QUAD
BROWNFIELD, PA.]

SIZE CLASSIFICATION

DAM SIZE - INTERMEDIATE (REF 1, TABLE 1)

HAZARD CLASSIFICATION - HIGH (FIELD OBSERVATION)

REQUIRED SDF - PMF (REF 1, TABLE 3)

NOTE: THE VALUE OF STORAGE CAPACITY IS TAKEN FROM AN UNPUBLISHED NOTEBOOK CONTAINING PERTINANT DATA FOR DAMS OPERATED BY THE UNIONTOWN BRANCH OF W.P.W.. THE NOTEBOOK IS AVAILABLE FROM THE FILES LOCATED AT UNIONTOWN OFFICE OF W.P.W.

A COMPARISON OF THE CALCULATIONS PRESENTED IN THIS TEXT WITH THOSE PREVIOUSLY SUBMITTED IN THE REPORT ENTITLED "HUTCHINSON RESERVOIR NO. 3 DAM", DATED SEPTEMBER 1978 WILL REVEAL SEVERAL DISCREPANCIES. THIS IS A DIRECT RESULT OF THE INCREASED ACCURACY REQUIRED TO SUCCESSFULLY COMPLETE THIS ANALYSIS ACCORDING TO THE REVISED GUIDELINES SET FORTH IN THIS CONTRACT. NEVERTHELESS, THE BOTTOM LINE END RESULT HAS REMAINED VIRTUALLY UNCHANGED.

SUBJECT DAM SAFETY INSPECTION.
HUTCHINSON RESERVOIR # 3
 BY KHK DATE 10-13-78 PROJ. NO. 78-617-216
 CHKD. BY RFJ DATE 10-18-78 SHEET NO. 2 OF 15



HUTCHINSON RESERVOIR # 3

DRAINAGE AREA. = 1.9 SQ. MILES (PLANIMETERED)

SURFACE AREA

NORMAL POOL (ELEV. 1430.5)* = 0.20 SQ. INC (PLANIMETERED)

(THIS EXCEEDS SURFACE AREA OF 18.36 ACRES GIVEN IN 3/14/74 LETTER FROM W.S. MCCRAY TO UNIONTOWN WATER CO., BUT CALCS. AND POOL LEVEL FOR 3/14/74 VALUE ARE NOT GIVEN. THEREFORE 18.36 ACRES WILL BE USED)

AREA AT CONTOUR 1440 = .28 SQ INC
 = 25.71 ACRES

$$\frac{\Delta A}{\Delta Y} = \text{RATE OF CHANGE IN AREA / FOOT RISE} = \frac{25.71 - 18.36}{1440 - 1430.5} = 0.77 \text{ AC/FT}$$

FREE BOARD = 2.8 FT

AREA AT THE TOP OF DAM ELEV. 1433.1 = 18.36 + 2.6 x .77
 = 20.4 ACRE-

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR #3
BY KHK DATE 10-20-78 PROJ. NO. 79-617-216
CHKD. BY RFV DATE 10-20-78 SHEET NO. 3 OF 15



* right ABUT. SPILLWAY IS 0.2' BELOW CREST OF LEFT ABUT. SPILLWAY. FROM
UNIONTOWN Water-Co. DWA 93-127, LT. ABUT. SPILLWAY CREST IS AT ELEVATION 1430.7'

UNIT HYDROGRAPH PARAMETERS

LENGTH OF LONGEST WATERCOURSE (L) \approx 2.95 MILES

LCA \approx 1.37 MILES

[VALUES OF L AND LCA ARE
FROM U.S.G.S. 7.5 MINUTE
SERIES QUAD BROWNFIELD, PA.]

NOTE: ALL VARIABLES ARE DEFINED IN REFERENCE 2 IN THE
SECTION ENTITLED "SNYDER SYNTHETIC UNIT HYDROGRAPH".

$C_t = 1.6$

$C_p = 0.5$

[SUPPLIED BY COF E;
ZONE 29, OHIO RIVER BASIN]

$t_p = \text{SNYDER'S STANDARD LAG} = 1.6 (L \times LCA)^{0.3}$

$t_p = (1.6) [(2.95)(1.37)]^{0.3} = 2.43 \text{ HRS}$

PMP CALCULATIONS

HUTCHINSON RESERVOIR #3 LOCATION \Rightarrow ZONE 7 (REF. 3)

PMP INDEX = 24 INCHES (FIG. 1, REF. 3)

DURATION % INDEX:

6 HRS = 102

12 HRS = 120

24 HRS = 130

NOTE: A 24-HOUR DURATION RATHER THAN A 48-HOUR
DURATION WAS USED. THIS WAS NECESSITATED
BY THE NEED TO USE A 5-MINUTE TIME STEP
IN THE HEC-E-DAM PROGRAM IN ORDER TO MORE
ACCURATELY DEFINE THE PEAKS OF THE HYDROGRAPH.
(A MAXIMUM OF ONLY 300 TIME INTERVALS IS
ALLOWED IN THE PROGRAM.)

SUBJECT DAM SAFETY INSPECTION.

HUTCHINSON RESERVOIR N° 3

BY KHK DATE 10-25-78 PROJ. NO. 78-617-216.

CHKD. BY WJV DATE 1/2/79 SHEET NO. 4 OF 15



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APPROXIMATE ELEVATION @ ZERO STORAGE

$$\text{VOLUME} = \frac{1}{3} \text{ HA} \quad (\text{CONIC METHOD})$$

$$A = 18.4 \text{ ACRES} \quad (\text{SHEET 2 OF CALCS}).$$

$$\text{NORMAL POOL VOLUME} = 340 \text{ A-F} \quad (\text{WPW FILES UNIONTOWN OFFICE})$$

$$H = \frac{340 \times 3}{18.4} = 55.43 \text{ FT.}$$
$$= \text{USE } 55 \text{ FT}$$

$$\text{NORMAL POOL ELEV} = 1430.5 \text{ FT.}$$

$$\text{ZERO VOLUME ELEV} = 1375.5 \text{ FT}$$

FURTHER, THE RATE OF CHANGE OF SURFACE AREA
PER FOOT OF RESERVOIR RISE BELOW
ELEVATION 1430.5:

$$\left(\frac{\Delta A}{\Delta Y}\right)' = 18.4 \text{ ACRES} / 55 \text{ FT} = 0.335 \frac{\text{ACRES}}{\text{FT}}$$

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR N^o 3
 BY WJV DATE 1/2/79 PROJ. NO. 78-617-216
 CHKD. BY DLB DATE 1/9/79 SHEET NO. 5 OF 15



ELEVATION - STORAGE RELATIONSHIP

- ESTIMATED SURFACE AREA: $A = A_0 + \left(\frac{\Delta A}{\Delta Y}\right) Y$

$A_0 = 18.4$ ACRES ABOVE EL. 1430.5, AND
 0.0 ACRES BELOW;

$\frac{\Delta A}{\Delta Y} = 0.77$ AC/FT ABOVE EL. 1430.5, AND
 0.335 AC/FT BELOW; AND

$Y = [(ELEVATION OF CONCERN) - 1430.5 \text{ FT}]$ ABOVE 1430.5 FT
 AND $[(ELEVATION OF CONCERN) - 1375.5 \text{ FT}]$ BELOW

- ESTIMATED INCREMENTAL INCREASE IN STORAGE ABOVE EL. 1430.5 FT

MODIFIED PRISMOIDAL FORMULA: $\Delta V_{1-2} = \frac{Y}{3} (A_1 + A_2 + \sqrt{A_1 \cdot A_2})$
 (REF. 14, PG 15)

- ESTIMATED STORAGE BELOW 1430.5 FT:

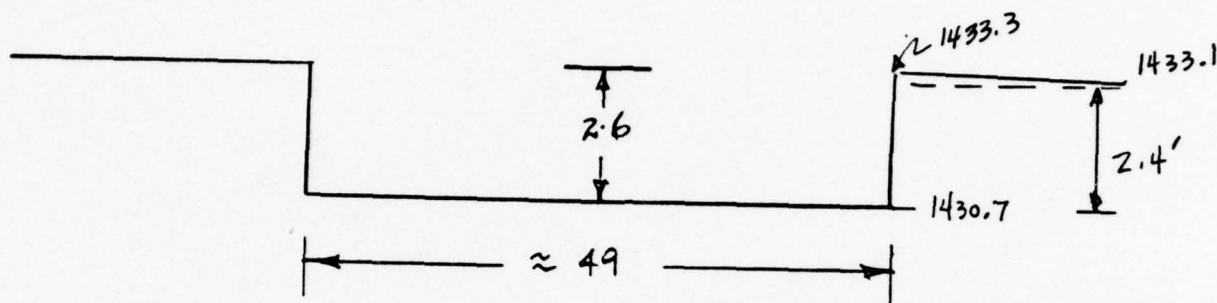
CONIC FORMULA: $V = \frac{1}{3} H A$ (where $H = Y$)

| ELEVATION (FT) | H (FT) | ESTIMATED AREA (ACRE) | ESTIMATED STORAGE (A-F) | ELEVATION (FT) | Y (FT) | ESTIMATED AREA (ACRE) | INCREMENTAL STORAGE (A-F) | CUMULATIVE STORAGE (A-F) |
|-------------------------|-----------|-----------------------------|-------------------------------|-------------------|-----------|-----------------------------|---------------------------------|--------------------------------|
| 1375.5 | 0 | 0 | 0 | 1431.5 | 1 | 19.2 | 19.8 | 358.8 |
| 1380.5 | 5 | 1.67 | 3 | 1432.5 | 2 | 19.9 | 19.5 | 378.3 |
| 1385.5 | 10 | 3.35 | 11 | 1433.3 | 2.8 | 20.6 | 16.1 | 394.4 |
| 1390.5 | 15 | 5.00 | 25 | 1433.5 | 3 | 20.7 | 4.1 | 398.5 |
| 1395.5 | 20 | 6.70 | 45 | 1434.5 | 4 | 21.5 | 21.1 | 419.6 |
| 1400.5 | 25 | 8.36 | 70 | 1435.5 | 5 | 22.3 | 21.8 | 441.4 |
| 1405.5 | 30 | 10.0 | 100 | 1436.5 | 6 | 23.0 | 22.6 | 464.0 |
| 1410.5 | 35 | 11.7 | 137 | 1437.5 | 7 | 23.8 | 23.4 | 487.4 |
| 1420.5 | 45 | 15.0 | 226 | | | | | |
| 1425.5 | 50 | 16.7 | 290 | | | | | |
| NORMAL POOL - 1430.5 | 55 | 18.4 | 340 | | | | | |

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR No 3
 BY KHK DATE 10-17-78 PROJ. NO. 78-617-216
 CHKD. BY RFV DATE 10-19-78 SHEET NO. 6 OF 15



CAPACITY OF LEFT SPILLWAY



SUPERCritical FLOW IS ASSUMED TO OCCUR IN THE SPILLWAY CHANNEL SINCE THE DOWNSTREAM SLOPE IS ABOUT 3% (FIELD MEASUREMENTS). THE CRITICAL SECTION, THAT SECTION WHERE FLOW IS TRANSFORMED FROM SUBCRITICAL TO SUPERCritical FLOW IS ASSUMED TO BE AT THE SPILLWAY INLET.

LET H_s = SPECIFIC ENERGY HEAD = $y + \frac{V^2}{2g}$ (REF. 13, PG. 134)
 IN RESERVOIR, V IS NEGLIGIBLE $\Rightarrow H_s = H = 2.4$ FT

AT SPILLWAY INLET $H_s = y_c + \frac{V_c^2}{2g}$ (CRITICAL CONDITIONS)

$$\therefore y_c + \frac{V_c^2}{2g} = H$$

SUBJECT DAM SAFETY INSPECTION.

HUTHINSON RESERVOIR No 3

BY KHK DATE 10-17-78 PROJ. NO. 78-617-216

CHKD. BY RFV DATE 10-19-78 SHEET NO. 7 OF 15



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$$\text{CRITICAL DEPTH} = \frac{V_c^2}{2g} = \frac{D_c}{2} \quad (\text{REF 13, PG. 143})$$

IN RECTANGULAR CHANNEL

$$\text{WHERE } D_c = \text{HYDRAULIC DEPTH} = \frac{\text{AREA}}{\text{TOP WIDTH}} = \frac{A_c}{W_c}$$

$$A_c = 49 y_c$$

$$W_c = 49'$$

$$y_c + \frac{49 y_c}{2 \times 49} = H = 2.4'$$

$$y_c + \frac{y_c}{2} = H = 2.4'$$

$$1.5 y_c = 2.4'$$

$$y_c = 1.60'$$

$$\frac{V_c^2}{2g} = \frac{D_c}{2} = \frac{49 \times 1.60}{2(49)} = 0.800$$

$$V_c^2 = 64.4 \times 0.800$$

$$V_c = 7.18 \text{ FPS.}$$

$$Q_c = V_c \times A_c = 7.18 \times 49 \times 1.60 = 563 \text{ CFS}$$

SUBJECT

DAM SAFETY INSPECTION.HUTCHINSON RESERVOIR N^o 3

BY

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DATE

10-17-78

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10-19-78

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DETERMINE THE CRITICAL SLOPE.

$$Q_c = \frac{1.49}{n} A_c R_c^{2/3} \sqrt{S_c} \quad \left(\begin{array}{l} \text{MANNING EQ,} \\ \text{REF 13, PG 143} \end{array} \right)$$

$$\text{OR} \quad S_c = \left(\frac{Q_c n}{1.49 A_c R_c^{2/3}} \right)^2$$

$$R_c = \frac{\text{AREA}}{\text{WETTED PERIMETER}} = \frac{49 \times 1.60}{49 + 2 \times 1.60} = 1.50'$$

$$n = .014 \quad \text{CONCRETE LINED} \quad \left(\begin{array}{l} \text{REF 7} \\ \text{PAGE 116.} \end{array} \right)$$

$$S_c = \left(\frac{563 \times .014}{1.49 \times 78.40 \times (1.50)^{2/3}} \right)^2 = 0.00265$$

$$= 0.265\% < 3\%$$

CRITICAL SLOPE IS LESS THAN ACTUAL SLOPE ; THUS
SUPER CRITICAL FLOW DOES OCCUR IN THE SPILLWAY

CHANNEL.

MAXIMUM
SPILLWAY
CAPACITY

$$\left\{ \begin{array}{l} Q = Q_c = 563 \text{ CFS.} \end{array} \right.$$

SUBJECT DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR N° 3

CHKD. BY KHIC DATE 10-17-78 PROJ. NO. 78-617-216

CHKD. BY RFU DATE 10-19-78 SHEET NO. 9 OF 15



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ELEVATION DISCHARGE RELATIONSHIP FOR LEFT SPILLWAY

THE PROCEDURE USED TO CALCULATE THE SPILLWAY
CAPACITY ON SHEETS 6 AND 7 WILL BE FOLLOWED TO
DETERMINE THE DISCHARGE VALUES :

$$y_c = H/1.5$$

$$V_c = \left(64.4 \frac{y_c}{2} \right)^{1/2}$$

$$Q_c = V_c \times A_c$$

| H HEIGHT ABOVE SPILLWAY CREST (FT) | ELEVATION ABOVE M.S.L (FT) | y_c (FT) | V_c FT/SEC | A_c SQ. FT | Q_c CFS. |
|---|----------------------------------|---------------|-----------------|-----------------|---------------|
| 0 | 1430.7 | 0 | 0 | 0 | 0 |
| 0.8 | 1431.5 | 0.53 | 4.13 | 25.97 | 107 |
| 1.8 | 1432.5 | 1.2 | 6.22 | 58.8 | 366 |
| 2.4 | 1433.1 | 1.60 | 7.18 | 78.40 | 563 |
| 2.8 | 1433.5 | 1.87 | 7.76 | 91.63 | 711 |
| 3.8 | 1434.5 | 2.53 | 9.03 | 123.97 | 1119 |
| 4.8 | 1435.5 | 3.2 | 10.15 | 156.8 | 1592 |
| 5.8 | 1436.5 | 3.87 | 11.16 | 189.63 | 2116 |
| 6.8 | 1437.5 | 4.53 | 12.07 | 221.97 | 2679 |

SUBJECT

DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR N° 3

BY

KHV

DATE

10-17-78

PROJ. NO.

78-617-216

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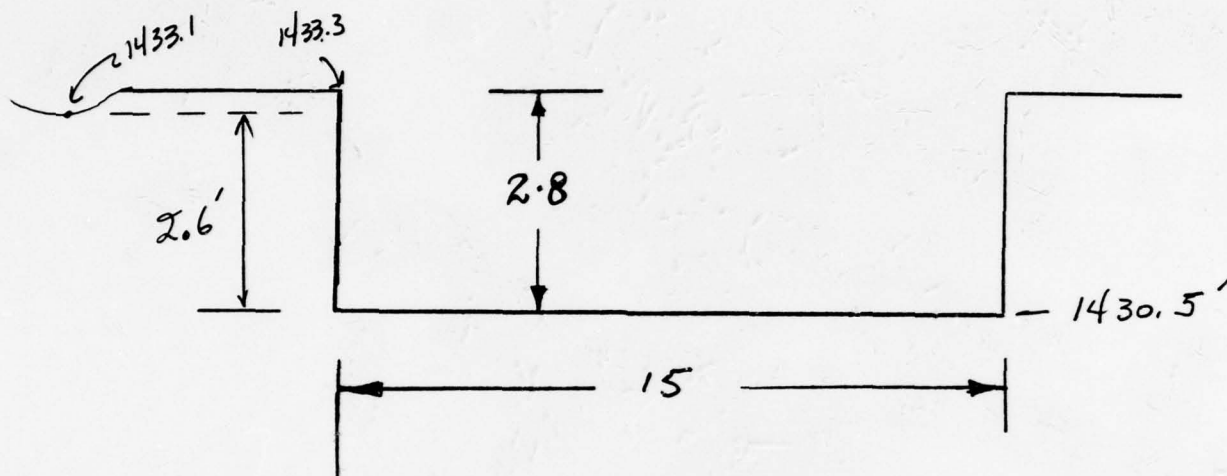
RFV

DATE

10-19-78

SHEET NO.

10 OF 15

Engineers • Geologists • Planners
Environmental SpecialistsCAPACITY OF RIGHT SPILLWAY.

SUPERCritical FLOW IS ASSUMED AS THE SLOPE OF SPILLWAY CHANNEL IS GREATER THAN 5%

$$\text{LET SPECIFIC HEAD } H_s = y + \frac{V^2}{2g} \quad (\text{REF 13, PG 139})$$

IN RESERVOIR, V , IS NEGLIGIBLE $\Rightarrow H_s = H = 2.6 \text{ FT.}$

$$\text{AT SPILLWAY INLET } H_s = y_c + \frac{V_c^2}{2g} \quad (\text{CRITICAL CONDITIONS})$$

$$\therefore y_c + \frac{V_c^2}{2g} = H$$

$$\text{CRITICAL DEPTH} = \frac{V_c^2}{2g} = \frac{D_c}{2} \quad (\text{REF 13, PG. 143})$$

$$\text{WHERE } D_c = \text{HYDRAULIC DEPTH} = \frac{\text{AREA}}{\text{TOP WIDTH}} = \frac{A_c}{W_c}$$

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR N° 3
 BY KHK DATE 10-17-78 PROJ. NO. 78-617-216
 CHKD. BY RFV DATE 10-19-78 SHEET NO. 11 OF 15

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$$A_c = 15 y_c$$

$$w_c = 15$$

$$y_c + \frac{15 y_c}{2 \times 15} = 2.6$$

$$1.5 y_c = 2.6$$

$$y_c = 1.73$$

$$V_c^2 / 2g = \frac{D_c}{2} = \frac{15 \times 1.73}{2 \times 15} = 0.865$$

$$V_c^2 = 64.4 \times 0.865$$

$$V = 7.46 \text{ FT/SEC.}$$

$$Q = V_c \times A_c = 7.46 \times 15 \times 1.73 = 194 \text{ CFS.}$$

CHECK SLOPE : (SEE SHEET 8)

$$S_c = \left(\frac{Q_c n}{1.49 A_c R_c^{2/3}} \right)^2 \Rightarrow \begin{aligned} Q_c &= 194 \text{ CFS} \\ n &= 0.014 \text{ (REF 7, PG. 116)} \\ A_c &= (15')(1.73') = 26.0 \text{ FT}^2 \\ R_c &= 26.0 \text{ FT}^2 / (15' + 1.73' + 1.73') = 1.41 \text{ FT} \end{aligned}$$

$$\therefore S_c = \left[\frac{(194)(0.014)}{1.49(26.0)(1.41)^{2/3}} \right]^2 = 0.31\% < 5\%$$

\Rightarrow CRITICAL FLOW CONTROLS

MAXIMUM SPILLWAY CAPACITY = 194 CFS

SUBJECT

DAM SAFETY INSPECTIONHUTCHINSON RESERVOIR N^o 3BY KHKDATE 10-16-78PROJ. NO. 78-617-216CHKD. BY RFVDATE 10-19-78SHEET NO. 12 OF 15Engineers • Geologists • Planners
Environmental SpecialistsELEVATION DISCHARGE RELATIONSHIP FOR RIGHT SPILLWAY

THE PROCEDURE USED TO CALCULATE THE SPILLWAY CAPACITY
ON SHEETS 10 AND 11 WILL BE FOLLOWED TO DETERMINE THE DISCHARGE VALUES:

$$y_c = H/1.5$$

$$V_c = \left(64.4 \frac{y_c}{2} \right)^{1/2}$$

$$Q_c = V_c \times A_c$$

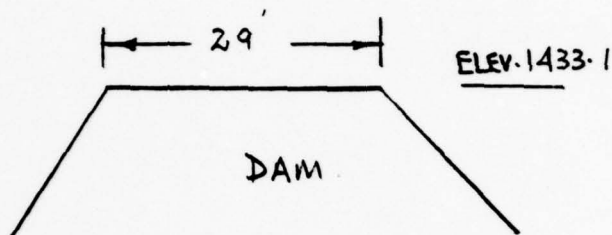
| H HEIGHT ABOVE SPILLWAY CREST FT. | ELEVATION ABOVE M.S.L. FT. | y_c FT. | V_c FT/SEC. | A_c SQ. FT. | Q_c CFS. |
|--|----------------------------------|--------------|------------------|------------------|---------------|
| 0 | 1430.5 | - | - | - | - |
| 1 | 1431.5 | 0.67 | 4.6 | 10.05 | 46 |
| 2 | 1432.5 | 1.33 | 6.5 | 19.95 | 130 |
| 2.6 | 1433.1 | 1.73 | 7.46 | 25.95 | 194 |
| 3 | 1433.5 | 2 | 8.02 | 30 | 241 |
| 4 | 1434.5 | 2.67 | 9.27 | 40.05 | 371 |
| 5 | 1435.5 | 3.33 | 10.35 | 49.95 | 517 |
| 6 | 1436.5 | 4 | 11.34 | 60 | 680 |
| 7 | 1437.5 | 4.67 | 12.26 | 70.05 | 859 |

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR N° 3
 BY KW DATE 10-18-78 PROJ. NO. 78-617-216
 CHKD. BY RFV DATE 10-19-78 SHEET NO. 13 OF 15

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DISCHARGE DUE TO DAM OVERTOPPING.

AVE CREST WIDTH = 29'
 CREST ELEVATION = 1433.1
 CREST LENGTH = 400



$$Q = CLH^{3/2}$$

| ELEVATION | H (FT) | H/L | C* | Q CFS. |
|-----------|--------|------|------|-----------|
| 1433.1 | 0 | - | - | - |
| 1433.5 | 0.4 | .014 | 3.00 | 304 |
| 1434.5 | 1.4 | .05 | 3.04 | 2,014 |
| 1435.5 | 2.4 | .08 | 3.05 | 4,536 |
| 1436.5 | 3.4 | .12 | 3.05 | 7,649 |
| 1437.5 | 4.4 | .15 | 3.05 | 11,260 |

* DISCHARGE COEFFICIENT BASED ON CRITERIA FOR
 EMBANKMENT SHAPED WEIRS - FIG 24 REF 12 (1970)

SUBJECT DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR N^o 3

BY WJV DATE 11/29/78 PROJ. NO. 78-617-216

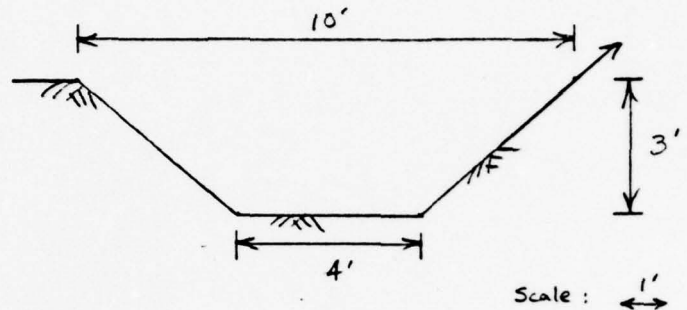
CHKD. BY DLB DATE 11/30/78 SHEET NO. 14 OF 15



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RACEWAY ANALYSIS

TYPICAL CROSS SECTION :



RACEWAY CAPACITY = 126 CFS

("HUTCHINSON RESERVOIR N^o 3 DAM"
PHASE I INSPECTION REPORT, NATIONAL
DAM INSPECTION PROGRAM, BY GAI
CONSULTANTS, INC FOR THE BALTIMORE
DISTRICT CORPS OF ENGINEERS)

APPROXIMATE RACEWAY LENGTH = 1600 FT

APPROXIMATE RACEWAY STORAGE CAPACITY @ FULL FLOW :

STORAGE = AVERAGE SURFACE AREA × AVERAGE DEPTH

$$\text{STORAGE} = [(10' \times 1600') + (4' \times 1600')] \times \frac{3'}{2} = 33600 \text{ FT}^3 \\ = 0.77 \text{ AC-FT}$$

RACEWAY STORAGE IS INSIGNIFICANT AND WILL BE NEGLECTED
IN THE SPILLWAY ANALYSIS

ASSUME RACEWAY FLOWS FULL BY THE TIME THE RESERVOIR
LEVEL RAISES 5 FT (FROM ELEV 1375.5 @ "0" RESERVOIR STORAGE
TO ELEV 1380.5) ⇒ RACEWAY FLOWS FULL SHORTLY AFTER BEGINNING
OF DIRECT RUNOFF GENERATION

SUBJECT DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR No 3

BY KHK DATE 10-18-78 PROJ. NO. 78-617-216

CHKD. BY RFU DATE 10-19-78 SHEET NO. 15 OF 15



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COMBINED DISCHARGE RATING CURVE

| ELEVATION | RAVEWAY | RIGHT SPILLWAY CFS | LEFT SPILLWAY CFS | OVERTOPPING DAM CFS | COMBINED Q CFS. |
|-----------|---------|--------------------------|-------------------------|---------------------------|-----------------------|
| 1430.5 | 0 | 0 | - | - | - |
| 1431.5 | 126 | 46 | 107 | - | 279 |
| 1432.5 | 126 | 130 | 366 | - | 622 |
| 1433.1 | 126 | 194 | 563 | 0 | 883 |
| 1433.5 | 126 | 241 | 711 | 304 | 1382 |
| 1434.5 | 126 | 371 | 1119 | 2,014 | 3630 |
| 1435.5 | 126 | 517 | 1592 | 4,536 | 6771 |
| 1436.5 | 126 | 680 | 2116 | 7,649 | 10571 |
| 1437.5 | 126 | 859 | 2679 | 11,260 | 14924 |

APPENDIX D
PHOTOGRAPHS

PHOTOGRAPH 1

View along the crest of Hutchinson Reservoir Dam No. 1 from the right abutment. The spillway is visible in the foreground and the gate control platform is shown on the upstream side of the dam near the center of the embankment.

PHOTOGRAPH 2

View of the downstream face of Dam No. 1 from approximately 300 feet downstream. The spillway is shown on the left and the chlorination hut in the center of the photograph.

PHOTOGRAPH 3

View of the valley immediately downstream of Dam No. 1.

PHOTOGRAPH 4

Close-up view of a depression (sinkhole) on the upstream side of the crest near the embankment center.



2



4



1



3

PHOTOGRAPH 5 Close-up view of the stepped spillway located on the right abutment.
Note the cracking in the sidewalls near the field team members.

PHOTOGRAPH 6 View of the Dam No. 1 spillway. The steel pipe on the left side
of the photograph conveys water from Hutchinson Reservoir No. 2 Dam.
The pipe can be uncoupled (at the black section) and used as a blowoff
line if necessary.

PHOTOGRAPH 7 View of Hutchinson Reservoir No. 1 Dam from the upstream reach of the
reservoir. Minor sedimentation is indicated in the foreground.

PHOTOGRAPH 8 View of the diversion ditch that conveys runoff around the right side
of Reservoir No. 1.



6



8



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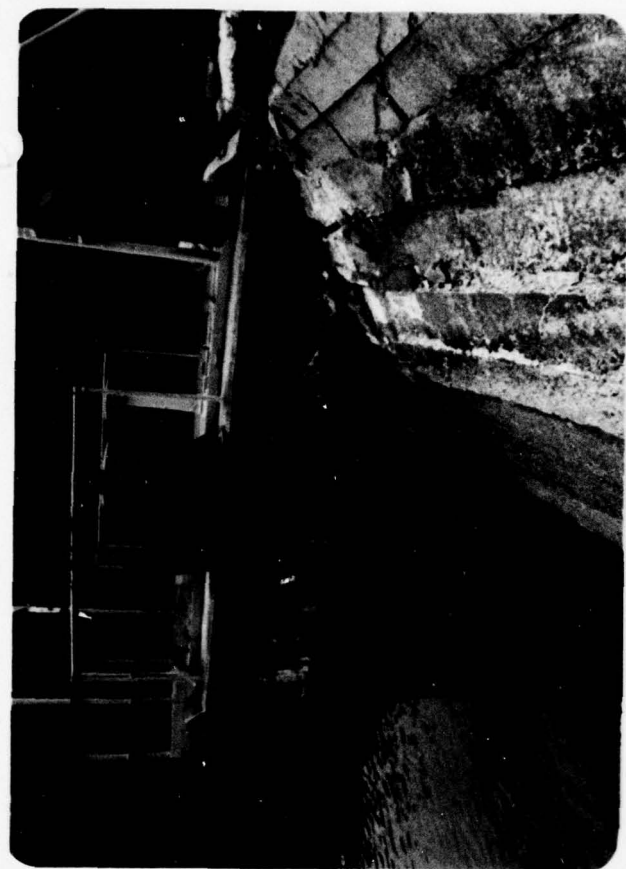
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PHOTOGRAPH 9 Close-up view of the valve controls on the Dam No. 1 outlet system.

PHOTOGRAPH 10 View of the cracked upstream face of the Dam No. 1 embankment. Note the cracking and rotation of the riser portion of the gate chamber. (vault)

PHOTOGRAPH 11 View of the discharge end of the 14-inch diameter blowoff pipe (inundated).

PHOTOGRAPH 12 Close-up view of a sediment laden area near the toe of the embankment adjacent to the left abutment.



10



12



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11

PHOTOGRAPH 13 View of some multiple family dwellings located adjacent to Redstone
Creek approximately one mile downstream of Dam No. 1.



APPENDIX E

GEOLOGY

GEOLOGY

Hutchinson Reservoir Nos. 1, 2, and 3 are located approximately 3 miles southeast of Uniontown on the western edge of the Allegheny Mountains section of the Appalachian Plateaus Province. The Allegheny Mountain section is characterized by gently folded sedimentary rock strata of Pennsylvanian age or older. Major structural axes strike from southwest to northeast with flanking strata dipping northwest and southeast.

Structurally, the dam and reservoir lie immediately west of the Chestnut Ridge anticline. The bedrock flanking the west side of Chestnut Ridge consist of Devonian and Mississippian age strata in the higher elevations of the watershed and Pennsylvanian age strata in the vicinity of the reservoirs and below. Near both dams the sedimentary rock strata dip to the northwest at approximately 1,800 feet per mile or 19 degrees.

Two widely spaced joint systems at right angles to each other commonly control drainage patterns on the flanks of Pennsylvania's ridges. In the vicinity of the site, the joint system striking N60°W is at right angles to the anticlinal axis and tends to align drainage patterns off the ridge in this direction. A secondary joint system parallels the anticlinal axis striking N30°E. The secondary system generally has a lesser influence on controlling drainage patterns. Redstone Creek, however, is strongly controlled

by both joint systems. The creek channel both above and below the Hutchinson reservoirs follow the primary N60°W bearing, whereas the section of Redstone Creek containing the reservoirs following the secondary N30°E bearing (see Regional Vicinity Map Appendix G). This abrupt directional change in the flow of Redstone Creek is not common in this section of Chestnut Ridge. Furthermore, a small fault, located about one mile northeast of the reservoirs is also known to strike along this same N30°E bearing. A strong structural influence is evidently controlling the direction of drainage along the section of Redstone Creek containing the Hutchinson reservoirs. Jointing and possibly faulting may be responsible for this drainage control. The influence this feature may have, if any, on the Hutchinson reservoirs is unknown, although it may have some bearing on seepage losses through the foundation of the reservoirs.

The strata underlying the alluvial and residual soils of the valley are members of the Allegheny Formation which is lower Pennsylvanian age. The group consists of shale and sandstone with lesser amounts of coal, clay, and limestone. The base is at the top of the Homewood sandstone and the top at the Upper Freeport coal which passes between Reservoir No. 2 and upstream of Reservoir No. 3. The Allegheny Formation is approximately 150 to 160 feet thick in the vicinity of the reservoirs.

The Upper Freeport coal occurs above Reservoirs No. 1 and 2 along the west valley wall. The coal in this area is considered to average about four feet thick with several thick clay and shale partings. The coal is generally of good thickness and quality, but has not been prospected to any great extent. At the time of the inspection, there was no evidence of mining in the immediate area.

REFERENCES

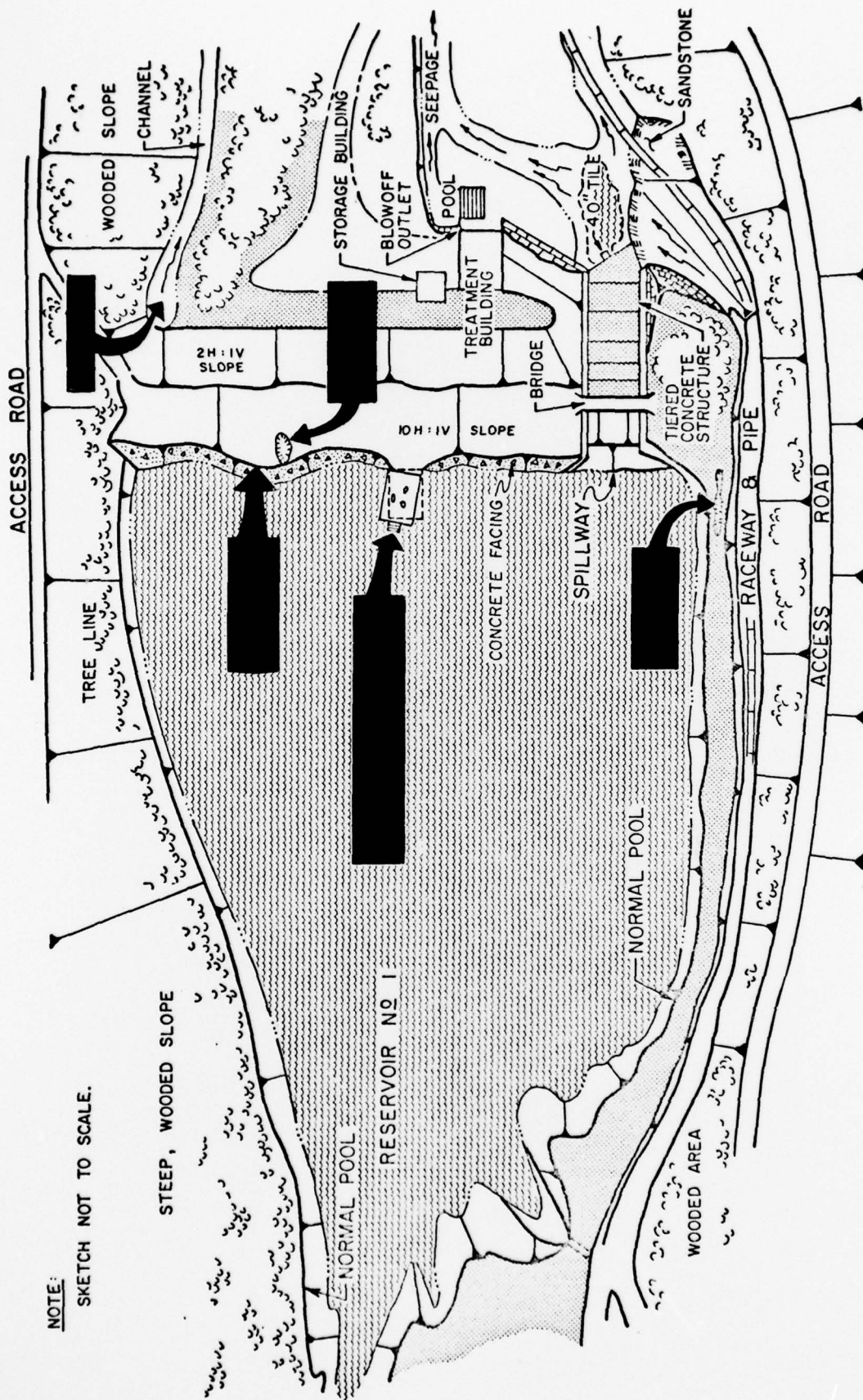
1. Cathcart, S. H., W. O. Hickok, IV, and F. T. Moyer, Geologic Map of Fayette County, Pennsylvania: Harrisburg, Pennsylvania: Topographic and Geologic Survey, 1938.
2. Hickok, W. O., IV, and F. T. Moyer, Geology and Mineral Resources of Fayette County, Pennsylvania: Harrisburg, Pennsylvania: Topographic and Geologic Survey, 1940.
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APPENDIX F

FIGURES

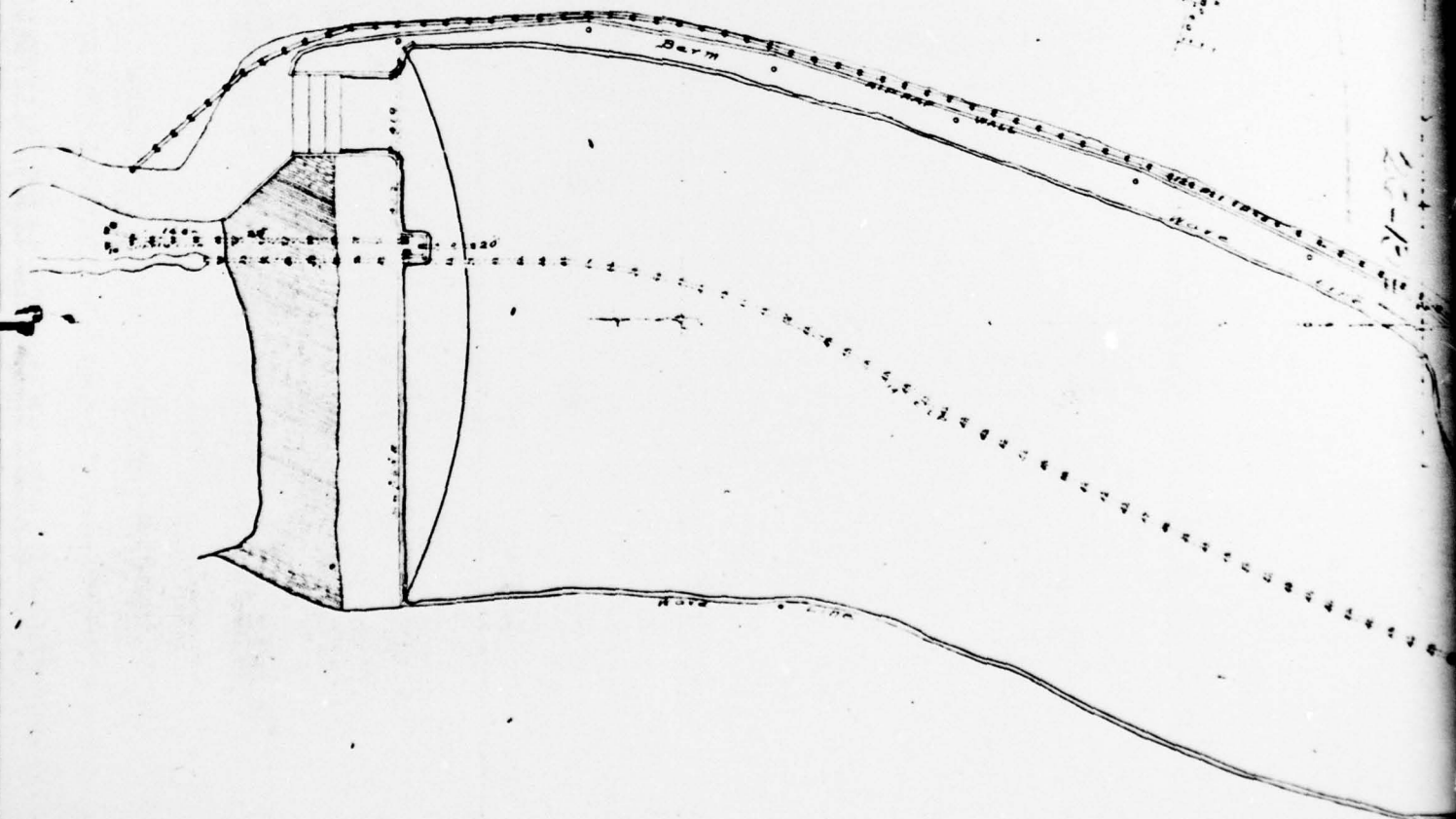
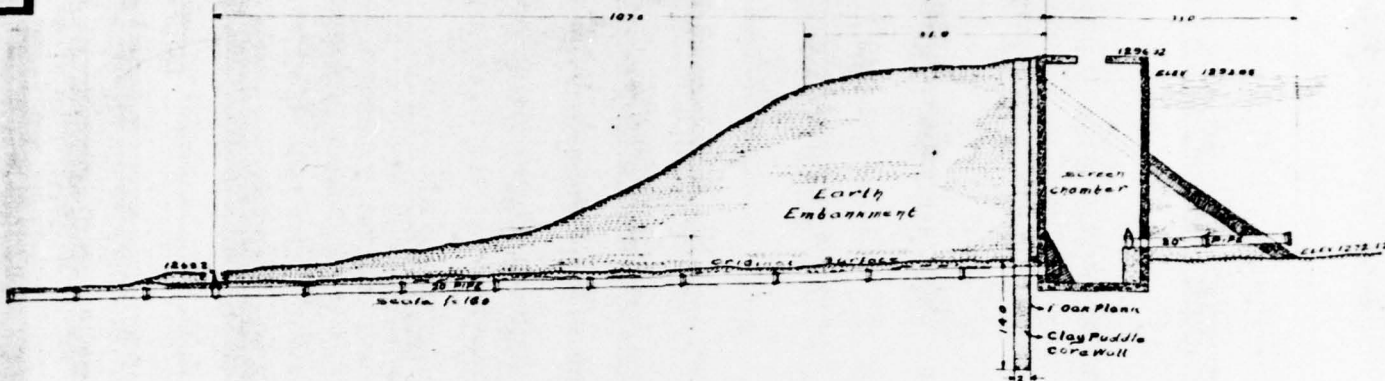
LIST OF FIGURES

| <u>Figure</u> | <u>Description/Title</u> |
|---------------|---------------------------------|
| 1 | Plan (Field Sketch) |
| 2 | Plan and Profile (1914 Drawing) |
| 3 | Cross-section (1915 Drawing) |



NOTE:
SKETCH NOT TO SCALE.

FIGURE 1 - HUTCHINSON RESERVOIR DAM NO 1
GENERAL PLAN • FIELD INSPECTION NOTES



**UNIONTOWN WATER CO.
HUTCHISON RESERVOIR. N°1.**

SOUTH-UNION TOWNSHIP.

FAYETTE COUNTY, PA.

Scale 1-400

Dec 1914

W. M. CLAY ENGINEER, UNIONTOWN, PA.

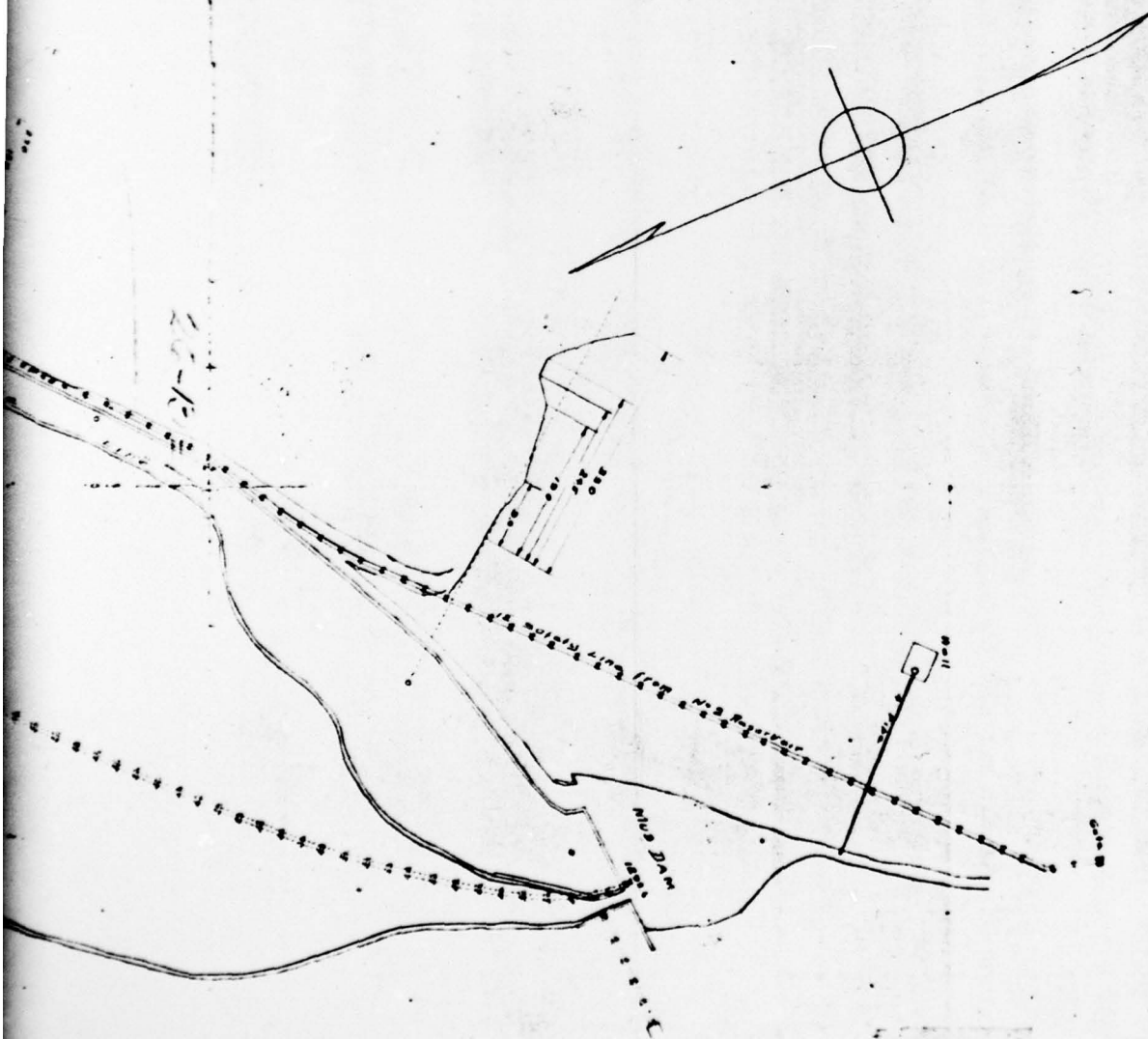
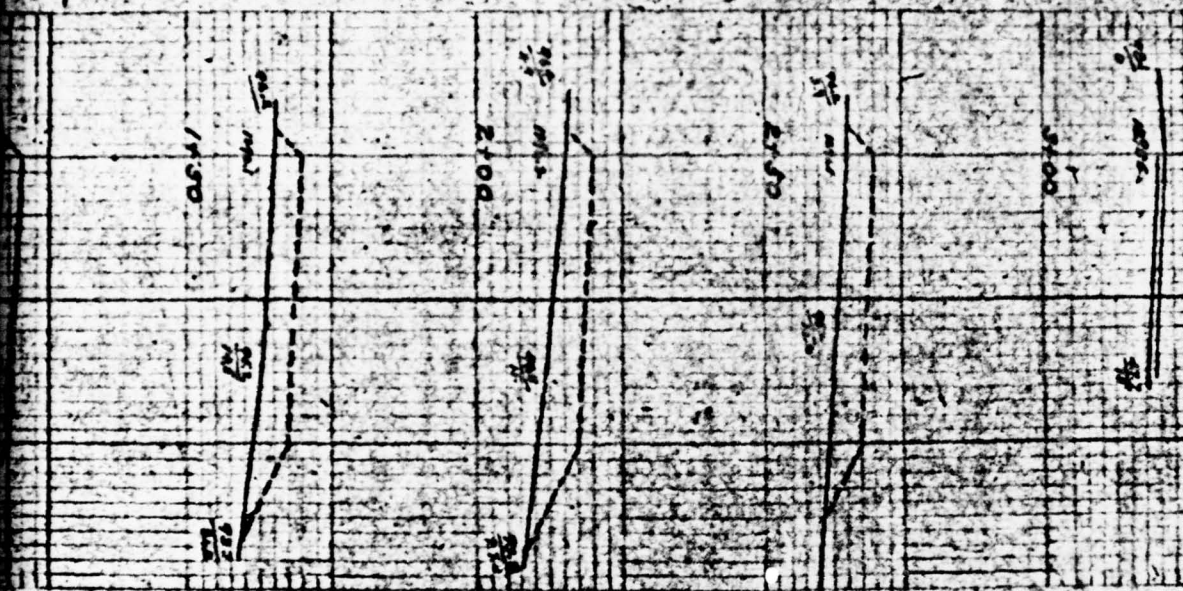
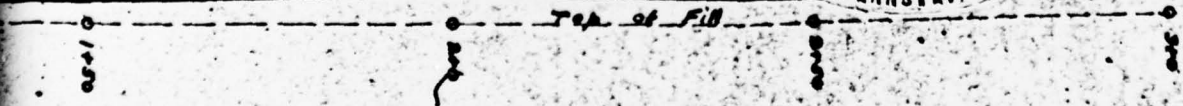


FIGURE 2



IGNMENT X-SECTION MAP
PROPOSED IMPROVEMENT
AT
HUTCHISON RESERVOIR NO. 1

UNIONTOWN WATER CO.
Uniontown, Fayette Co. Pa.



20 FT.

W.S. McCLAY, Engineer
Uniontown Pa.
June 1915

FIGURE 3

APPENDIX G
REGIONAL VICINITY MAP

--- LONGEST WATERCOURSE
● CENTROID OF DRAINAGE AREA

